FEDERAL AVIATION ADMINISTRATION'S RESEARCH AND DEVELOPMENT PROGRAM

HEARING

BEFORE THE

SUBCOMMITTEE ON
TECHNOLOGY AND COMPETITIVENESS

OF THE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY U.S. HOUSE OF REPRESENTATIVES

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FEDERAL AVIATION ADMINISTRATION'S RESEARCH AND DEVELOPMENT PROGRAM

THURSDAY, MAY 16, 1991

House of Representatives,
Committee on Science, Space, and Technology,
Subcommittee on Technology and Competitiveness,
Washington, DC.

The subcommittee met, pursuant to notice, at 9:30 a.m., in room 2325, Rayburn House Office, Hon. Tim Valentine (chairman of the subcommittee), presiding.

Mr. Valentine. We'll get started.

Let me say at the outset that the witness who appears first on today's agenda is Congressman Bill Hughes of New Jersey. I understand that he is presiding at a subcommittee and will be detained, so after the usual brief opening statements, we will proceed with the witnesses, and we will present our colleague as soon as possible after he arrives.

We convene today for an FAA oversight hearing on "Moving America into the 21st Century," the theme of their newly-generated research and development initiatives and long-range plans.

This subcommittee has not been particularly impressed, I might say, by the Administration's support of FAA research and development in recent years. After a surge of momentum at the beginning of the National Air Space Plan early in the 1980s, we have been unsuccessful in encouraging an aggressive pursuit of advancing technology to stave off yet more safety and traffic crises.

FAA performs a unique real time operation that reaches into every home in America. They are on duty all over the Nation, 24 hours a day, 365 days a year, and never shut down one minute for any reason.

The need for research to improve technology and enhance aviation safety appears to be, at least to some extent, lost on this Administration, in the opinion of some Members of Congress. Money collected from the public for this vital research sits idle in a bloated trust fund, while the Administration tries to find ways to get at it for other purposes.

Administrator Busey recognizes, we believe, his responsibilities. He is proposing a regenerated emphasis on research to advance the technologies needed for current operations, as well as for future demands. Today we will hear the content of that plan. This subcommittee is ready to support any reasonable commitment to avoid a repeat of the congestion and system crises of the 1960s and 1970s.

We appreciate the witnesses who have come here today and we look forward to their testimony.

[The prepared opening statement of Mr. Valentine follows:]

THE HONORABLE TIM VALENTINE, CHAIRMAN

Subcommittee on Technology and Competitiveness

FAA OVERSIGHT HEARING

May 16, 1991

We convene today for an FAA oversight hearing on "Moving America into the 21st Century", the theme of their newly generated Research and Development initiatives and long range plans.

This Committee has not been impressed by the Administration's support of FAA Research and Development in recent years. After a surge of momentum at the beginning of the National Air Space Plan early in the 80's, we have been unsuccessful in encouraging an aggressive pursuit of advancing technology to stave off yet more traffic and safety crises.

FAA performs a unique real time operation that reaches into every home in America. They are on duty all over the nation, 24 hours a day, 365 days a year and never shut down one minute for any reason. The need for research to improve technology and enhance aviation safety is lost on this Administration. Money collected from the public for this vital research sits idle in a bloated trust fund while the Administration tries to find ways to get at it for other purposes.

Administrator Busey recognizes his responsibilities. He is proposing a regenerated emphasis on research to advance the technologies needed for current operations as well as for future demands. Today we will hear the content of that plan. This committee is ready to support any reasonable commitment to avoid a repeat of the congestion and system crises of the 60's and 70's.

Mr. **Valentine**. The Chair recognizes the distinguished ranking member of the subcommittee, the gentleman from Florida, Mr. Lewis.

Mr. **Lewis**. Thank you, Mr. Chairman.

Mr. Chairman, I have prepared a more lengthy statement for the record in support of my very strong feelings on the important issues we will discuss here today. However, I will keep my comments brief in the interest of hearing from our witnesses and getting some of the answers we have been trying to get for far too long.

For more than three years I have done everything I can to think of how to get the FAA to begin an air safety research program in an effort to save lives and prevent preventable accidents. A bill I wrote, the Air Safety Research Act of 1988, became Public Law 100-591, requiring the FAA to do that research, but the FAA has ignored major provisions of that law.

This committee, both collectively and individually, has time and again asked the FAA to tell us how they will obey that particular law. Still, nothing tangible. But fatal accidents that could have been prevented continue to happen. A couple of cases in point:

The collision of a USAir 737 and a commuter plane on February 1 in LA killed 17 after impact and while they were trying to escape fire in the cabin; and

The crash of a 727 with a DC-9 that killed 9, also by fire and inhalation after impact.

The FAA reacted, also after the fact, instead of doing what was necessary to keep those deaths—or even better, those accidents—from occurring.

As far as I am concerned the day of reckoning is here, and I am here to get the answers and find out once and for all how the FAA plans to obey the law and protect the flying public, Mr. Chairman.

Thank you.

[The prepared opening statement of Mr. Lewis follows:]

Hon. Tom Lewis (R-FL)
Opening Statement
FAA R&D Oversight Hearing
May 16, 1991

Last December third on a runway in Detroit, a 727 sideswiped a DC-9 knocking off an engine. Eight aboard the DC-9 apparently survived the impact but died in the resulting fire. Press accounts indicate that passengers had difficulty getting to exits.

Public Law 100-591 mandates that the Federal Aviation Administration conduct or supervise research "...to develop advanced aircraft fuels with low flammability and technologies for containment of aircraft fuels for the purpose of minimizing post-crash fire hazards."

I have no information from FAA that the Agency has hired fire research scientists nor has the Agency begun a long-term research program to implement the provisions of the law. The question that FAA must answer is, if the Agency had started the mandated research in 1988, when the law was passed, could there have been a technology breakthrough that could have allowed a little more time for some of these passengers to escape?

On February 1, 1991 a US Air 737 collided with a commuter plane on the runway in Los Angeles. With one exception, all aboard the US Air survived the initial impact. However, press accounts indicate that while 17 aboard the 737 managed to unbuckle their seatbealts, all died before exiting the aircraft.

Public law 100-591 mandates that FAA undertake or supervise research "...to develop improved fire and smoke resistant aircraft materials" with the goal of a totally fire resistant cabin.

I have no information from FAA that the Agency has hired fire research scientists nor have they begun a long-term generic research program to develop an aircraft cabin that would give survivors of a crash more time to escape. However, the Agency does have a short-term fire research program directed primarily toward supporting the rule making process.

Again, the question that FAA must answer is, if the Agency had begun the research program mandated by law in 1988, could there have been enough progress in technology development that would have given just a little more time for at least some of those 17 passengers to escape?

Unfortunately, we will most likely never know the answer because FAA gave a higher priority toward tombstone technology rather that preventing accidents before they occur.

Some of the burden of guilt for the death of these passengers and others who may follow, rests on the shoulders of the Federal Aviation Administration.

It is a heavy burden. Since 1988 the Agency has produced plans, charts, and excuses but no research has been conducted in these mandated areas that could save lives. The Agency, until yesterday, had a policy of sending the explanation of the budget to the Appropriations Committee only.

Despite a letter sent by the Committee chairman in 1989, legislation requiring a policy due in 1990 and assurances by the FAA witness over a year ago, FAA would not acknowledge the jurisdiction of the Committee until yesterday. Finally, we will receive budget information to enable us to analyze the budget and the programs.

This is a welcomed step, but why did it take three years?

Even when Congress mandated that FAA include representatives from the flying public - a consumer - on the Scientific Advisory Board, FAA ignores the law and stacked the membership with representatives of special interest groups. How does the voice of flying public get heard at FAA regarding safety research concerns?

Finally, I hope today's hearing will reflect a new awaking at the Agency that this Committee is serious about the aviation safety research being the number one priority.

Mr. VALENTINE. Thank you, sir.

The Chair recognizes the gentleman from Arkansas, Mr. Ray Thornton.

Mr. THORNTON. Thank you, Mr. Chairman. I will not have a formal opening statement. I simply want to congratulate you, sir, for calling this very important hearing.

I personally have a dual opportunity here of reviewing, in an oversight capacity, the operations of the FAA, and also as a commercial pilot, I use their resources and I am familiar with some of the problems that they have.

I would also like to suggest that this is a matter of great interest. This committee has the responsibility of moving things forward to determine what can be accomplished through research and the application of the results of that research to increased air traffic safety. Another subcommittee on which I serve as part of Government Operations has recently reviewed the safety items themselves with regard to fire-resistant interiors of airplanes, the survivability of crashes. We want not only to have research applied to improving survivability of airplane crashes, but also the best technological information available in the world to prevent such accidents from happening.

Thank you, sir.

Mr. VALENTINE. Thank you very much.

The first panel will consist of Mr. Joseph M. Del Balzo and others accompanying him. He, of course, is well known to this subcommittee. We welcome him here. He is Executive Director for System Development, Federal Aviation Administration. And Mr. Frank J. Colson, Executive Director, Policy Board on Federal Aviation, from the Pentagon.

If you folks would step up and have a seat, as I stated, we will try to fit Mr. Hughes in when he arrives here.

Your prepared statements will appear in the record as presented to us. We would appreciate it very much if you would summarize. We will have a lot of questions and we have a lot of territory to cover. We would appreciate it very much if you could keep your summaries to no more than five minutes.

Mr. Del Balzo.

STATEMENT OF JOSEPH M. DEL BALZO, EXECUTIVE DIRECTOR FOR SYSTEM DEVELOPMENT, FEDERAL AVIATION ADMINISTRATION, ACCOMPANIED BY STEVE ZAIDMAN, ACTING DIRECTOR, RESEARCH AND DEVELOPMENT SERVICE; GUS SARKOS, MANAGER, FIRE SAFETY BRANCH, FAA TECHNICAL CENTER, ATLANTIC CITY, NJ; CLAY FOUSHEE, CHIEF SCIENTIFIC TECHNICAL ADVISER FOR HUMAN FACTORS, FAA; AND MIKE HARRISON, RUNWAY INCURSION PROGRAM MANAGER

Mr. DEL BALZO. Mr. Chairman, Congressman Lewis, Congressman Thornton, it is a pleasure to be here with you again this morning. I am accompanied by Steve Zaidman, who is the Acting Director of Research and Development in FAA; and Gus Sarkos, who I think a lot of you know, is the manager of the Fire Safety Branch at FAA's Technical Center in Atlantic City; and Dr. Clay

Foushee, who, as you also know, is the Chief Scientific Technical Advisor for Human Factors in FAA.

I do have a rather long statement for the record. As you suggest, I do appreciate the opportunity just to summarize some points that I would like to make before the committee this morning.

I don't think there's any question, and I say this on behalf of all of us involved in research and development at FAA, that we appreciate this subcommittee's longstanding support of an aggressive R&D program. Over the years I know you have had a hand in making the many choices which I believe have converged to produce the system that is taking shape today.

This is the third time I have appeared before you. The first time was in 1989, and it was right after the passage of the Aviation Safety Research Act of 1988. You know that that act was prepared and championed by this committee. That was an act that was aimed at revitalizing the agency's R&D program which, as I have told you before, I agreed needed a substantial overhaul.

If you recall, three years ago we set some rather ambitious goals, both for myself and for the organization. The first year was a year that was to be dedicated to constructing a comprehensive research plan, a plan that would meet the needs of the civil aviation community—not just for today, but well into the 21st century.

The second year was to focus on the building of an internal FAA capability to carry out that plan.

In this, our third year, we would be in position to aggressively implement all aspects of that research and development plan.

I look back on the past three years, and I tell you now that I was overly optimistic about what it is that we could achieve. The truth is that what I have found is that the task of revitalizing an R&D program is a difficult one. It has not taken us one year to produce a plan; it has taken us two and a half years. The good news is that I think today we come before you with a comprehensive and broadly-accepted research and development plan. Instead of the one-year time frame we had anticipated, it has taken us two and a half years.

Why did it take so long? I think that's a fair question. Until we began to question what we wanted to produce, what we had was an R&D plan that was nothing more than a collection of loosely-associated projects. This project shared no common goal and it had no direction, no vision of the future, until now. Now I think we have a vision of the future, and I think we have that vision because of the support and aggressive insistence that we've gotten from this subcommittee.

I think as a result what we have is a future system design that I believe is a vast improvement over the modernized system described in the first NAS Plan 10 years ago. Here is what we see.

We see a system of the future that is free from fatal accidents, a system of the future that is free from acts of terrorism, free from noise concerns, free from passenger delays, and a system of the future that will position the United States in terms of aviation technology and leadership in the world.

This focus represents our view of the future, a research and development dot on the horizon.

I just described high and lofty goals that aren't new, that shouldn't be new to this committee, because they are your high and lofty goals. You have said them before, and I think now we've listened.

We're building an internal capability, but the truth again is that we have not, until recently, been able to construct the comprehensive research plan that adequately addresses the long-term vision.

Over the last six months we have developed a draft R&D plan which is more than this list of R&D projects. It supports a vision and a set of goals that will take aviation into the 21st century. How did we do it? Why is it different this time? This time we didn't do it ourselves. This time we did it with the aviation community. We did it with our own internal users.

So I come before you today with an R&D plan that is not mine, it's FAA's. It's supported by our users within FAA, and I believe that's an historic first for us. This is an FAA plan. But more than that, I think what you will find is that it is a plan that has support because it was built by and with the aviation community.

It is aggressive. It will take aggressive resources and commitment by everyone to accomplish. It will address airport and aircraft security and safety goals, as well as the Air Traffic Control System.

So on the one hand, we haven't moved as fast as we would have all hoped for, but I feel good about what it is that we have produced and brought forward to you today. I would like to offer this subcommittee an opportunity for an advance briefing on this R&D plan, as well as an early addition of the plan, after the Administrator and Secretary endorse its goals and its objectives.

The good news is, I don't believe they will find anything in the plan that they will not fully support.

Let me take just a few minutes, if I could, to highlight some of the major changes, successes, and what I think some of our shortcomings have been since last year's hearing, and there have been some shortcomings. Let me start with the good news.

For the first time, we have identified, we have documented, and we have achieved broad consensus on a description of the Air Traffic Control System of tomorrow. We published it last month. It has been accepted already by a panel in ICAO as a world vision, and I think we're proud of that.

Terminal automation—we have developed systems that are already operational in St. Louis. When we came to you, we weren't sure that we could do that. As a result of the work that NASA Ames has done for us, we will be introducing terminal automation into our major TRACONs as early as 1992. A major TRACON, the New York TRACON, will have terminal automation by 1995.

GPS—we're doing a lot of work to ensure that GPS will be available to improve aircraft navigation. We're doing a lot of work in the satellite area. When one looks at the vision of tomorrow, there's no question that it is satellite-based: satellite technology for navigation, satellite technology for communications, and satellite technology for surveillance. We are cooperating with industry, other Government agencies such as NASA and DOD, and the international community in developing the satellite capability for civil aviation.

To give you more good news, a Northwest Airlines 747 airplane is already equipped with GPS and GLONASS receivers and currently operating on a new route to the Orient through Soviet airspace. The Soviets are developing a common receiver that can operate on either GPS or GLONASS, or a combination of satellites from both systems. We will have standards in place by 1995.

The list of good news things that we have delivered in the R&D program that you will find in the longer statement I think is significant and I think is impressive, and I won't take time to go through additional ones. I would like only to assure you that not just in the air traffic control area, but in the areas of security, explosive detection, and aircraft safety as well, we have in fact made significant progress.

The R&D plan that I talk about contains a host of new initiatives. As I mentioned, the development of the plan has in fact been a collaborative one, one that relied heavily on the work of the Research and Development Advisory Committee that you were so helpful in getting established for us. This committee has helped us in the planning process——

[Bell sounds.]

Mr. VALENTINE. That was a malfunction. We'll give you a little more time here. My aide de camp here has not been checked out on this machine yet. [Laughter.]

He can, however, fly twice the speed of sound. [Laughter.]

Mr. DEL BALZO. Just in case it was intentional, I'm coming to the end.

This Advisory Committee has helped us design the planning process that is responsive to the changing demands and new requirements. I would tell you that the committee has been just indispensable in structuring our proposed R&D plan and helping us formulate the vision of tomorrow in an air traffic system. It has proved the all-important link that we so sorely needed to the aviation community.

A lot of members of the committee have completed their two-year terms and will be leaving us soon. They take with them my deepest thanks and gratitude for their valuable contribution.

When we first established the committee, we needed to formulate the core R&D programs to focus on meeting user needs. That's all behind us now. I think we've done that. We expect now that the focus in membership of the committee will emphasize longer-term research activities.

Looking forward to exercising the grant authority and the Center of Excellence authority, again that this committee was helpful in ensuring that we had, our Technical Center in Atlantic City has established a structure and process to manage the grants program and to manage the Center of Excellence program. We plan to have initial grants in place by this coming summer.

We are building a research and development infrastructure that I think is on its way to becoming a world-class internal capability. I think we have success that I can point with pride to in terms of the quality of the new hires that we have made during these past 12 months, the quality of people that we now have on assignment to us through the Intergovernmental Personnel Act—we have six of what we call "IPAs," people from MIT, people from Carnegie

Mellon, and the list goes on. We are proud of the fact that we were able to establish a federally-funded research and development center through MITRE, as well as the development of Centers of Excellence.

I think the last subject I would raise with the committee is our continuing need to develop our in-house capability, because in the end our R&D program will rest with our ability to hire and retain the corps of highly trained specialists in a variety of disciplines. We need to also expand our capability to track projects from inception to completion.

There is no question, I feel good. Our accomplishments over the last year are many and significant. I also feel good about the direction and momentum now of our progress. I think we have a clear direction for the long-range development of aviation in the United States, and we are in the process of finalizing these elements in this year's R&D plan.

Those are the things I feel good about, but there are a couple of things I don't feel so good about, and I'll share those with you.

I don't feel good about the fact that we have not focused enough on basic research, long-term research, you're right. I think what we now have is a capability that will allow us to do that effectively, and that's the Center of Excellence capability. That's our plan to start to focus long-term research and basic research through a capability that I now don't believe that we can establish ourselves in-house.

I don't feel very good about the fact that we have been slow to realize the importance of human factors research. I feel good about what it is that we have produced. We know what it is that we want to do. Again, this is an area where we now have a comprehensive national plan for human factors research.

I don't feel good about what we haven't done in terms of speeding up the delivery of products from research and development into the field, but I feel good about knowing how it is that we are going to do it tomorrow, and I'll share that with you.

I don't feel good about the fact that there are no simple solutions to aviation security and terrorism. There is no single technology that will allow us to solve that problem, so we continue to search.

I don't feel good about the fact that aircraft are still vulnerable to catastrophic failures, but I think we have a research program that will address that issue.

Nor do I feel good about the fact that weather is still a major cause of general aviation accidents and aircraft safety. Again, I feel good about the fact that we have a direction.

But the single thing that I feel the worst about is our inability to have communicated all of the good news to this committee. That's not the committee's fault; that's my fault, because I think there has been a lot that we have done, but we have not ensured that you are aware of it. And I want to do that. I want to do that starting today. I want to do that when we leave today, because I don't believe we can communicate what we are doing and get your advice based on once-a-year hearings.

I invite you to the pre-briefings that I would like to expose you to, to tell you things that we are going to do ahead of time and seek your advice, and then keep you involved along the way, because I think we need your help and support.

Thank you.

[The prepared statement of Mr. Del Balzo follows:]

STATEMENT OF JOSEPH M. DEL BALZO, EXECUTIVE DIRECTOR FOR SYSTEM DEVELOPMENT, FEDERAL AVIATION ADMINISTRATION, BEFORE THE HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY, SUBCOMMITTEE ON TECHNOLOGY AND COMPETITIVENESS, CONCERNING THE FAA'S RESEARCH, ENGINEERING, AND DEVELOPMENT PROGRAM. May 16, 1991.

Mr. Chairman and Members of the Subcommittee:

Once again, I am pleased to have the opportunity to appear before you to discuss the FAA's research, engineering, and development program. With me today are Steve Zaidman, Acting Director of our Research and Development Service and Gus Sarkos, Manager, Fire Safety Branch at the FAA's Technical Center in Atlantic City.

On behalf of Administrator Busey and the entire system development organization, I would like to say that we appreciate this Subcommittee's longstanding support. Over the last several years, the Subcommittee has played a major role in the many choices which have converged to produce the national airspace system that is taking shape today.

When I first appeared before you in 1989, it was right after passage of the Aviation Safety Research Act of 1988, which was reported out of this Subcommittee. That Act is aimed at revitalizing the agency's R&D program which, quite frankly, needed an overhaul. At that time, three years ago, I set some ambitious goals for myself and my organization. The first year was dedicated primarily to constructing a comprehensive research plan--one which meets the needs of the civil aviation community well into the next century. The second year was to focus on building the internal FAA capability necessary to execute the plan. In the third year, this year, we were finally to be in a position to implement, in an aggressive fashion, all aspects of an applied and basic aviation research and development program.

Looking back now, I have to admit that I was overly optimistic and ambitious. I did not realize just how difficult the task of revitalizing a substantial R&D program is. Instead of taking one year to produce a comprehensive and broadly-accepted plan, it has taken more than two years.

Until we began to question what we ultimately wanted to produce, our R&D program amounted to no more than a group of loosely associated projects. They shared no common goals, no mutual direction. There was little sense of where or when they would fit into the agency's R&D grand scheme, because there was no vision of the future--until now.

Aided by this Subcommittee, we were able to define a future system that is a vast improvement over the modernized system described in the first NAS Plan 10 years ago. We now envision a twenty-first century aviation system which is safer, burdened with less noise, fewer fatal accidents, acts of terrorism, and passenger delays. This focus represents FAA's view of the future, its research and development "dot on the horizon". These may be high and lofty goals, but we are committed to them.

We are building the internal capability. We are developing the draft Fiscal Year 1991 R,E&D Plan which is far more than a list of R,E&D projects; it supports the vision and set of goals that will take the aviation community well into the twenty-first century. The Plan has been developed with internal and external user community input, and embodies the programs and schedules necessary to accommodate forecasted requirements. It is an aggressive plan, and will take aggressive resources and commitment by all the players to accomplish.

I am committed to having this Plan address airport and aircraft security and safety goals as completely as we have laid out the course for the air traffic management capability. While we have not fully accomplished my aggressive goals, I feel good about our direction and the accomplishments we have achieved to date. I would like to take a few minutes to summarize some of the major changes which have taken place in our R&D program since last year's hearing and to tell you some of our successes.

For the first time, we have identified, documented, and achieved broad community consensus on the description of the future air traffic management system in the United States. This document describes foreseen applications of satellite and other new technologies for communications, navigation, and surveillance as well as improved aviation weather system capabilities based on new weather observation technologies, sophisticated weather data processors, and new weather product distribution systems. Automation in the cockpit and on the ground, fully compatible with the capabilities of human operators, will increase system capacity as well as the safety and efficiency of flight operations.

In the terminal automation area, we have developed a converging runway display aid that will permit simultaneous operation of converging and intersecting runways under instrument weather conditions that today would force us to close one of the two runways. The display aid will be implemented in our ARTS IIIA terminal automation equipment beginning in mid-1992. Thirty sites will accrue operational benefits with capacity increases approaching 30 percent at some sites.

A more sophisticated series of terminal automation aids is being developed in cooperation with NASA under the Terminal ATC Automation (TATCA) project. Comprehensive computer-based planning will assist controllers in sequencing and scheduling arrival traffic in order to make best use of available runways. Capacity improvements approaching 25 percent may be achieved for a single runway in instrument weather conditions. We expect to initiate field evaluations of these techniques at Denver and Dallas/Ft. Worth beginning in 1992. National deployment is anticipated in the 1994-1995 time frame.

In the satellite navigation area, the Global Positioning System, GPS, will improve aircraft navigation and assure more accurate position reporting over oceans and in remote areas where radar coverage is not available. Tactical air traffic control practices similar to those used in domestic airspace today may also be feasible. The inherent safety benefits are apparent; and reduced separations between aircraft may be possible yielding increased airspace capacities. Satellite navigation may enable aircraft to use virtually any airport in the world in instrument weather conditions approaching Category I landing minimums (200 foot ceiling, 1/2 mile visibility). Finally, we are actively investigating satellites as a means for navigation and surveillance on the airport surface in low visibility conditions, thereby helping to reduce the frequency of runway incursions and other airport surface accidents.

We are cooperating extensively with industry, other government agencies, and the international community in the development of satellite navigation capability for civil aviation. In particular, a Northwest Airlines Boeing 747 aircraft, equipped with both a GPS receiver and a Soviet GLONASS receiver is currently operating on a new route to the Orient through Soviet airspace. This operational evaluation of satellite navigation capability is a precursor to a new era of cooperation in accommodating the routing requirements of international operators. In a second cooperative initiative with the Soviets and the international community, we are jointly developing a common receiver that can operate with both GPS and GLONASS satellites. We expect to have standards in place to support the certification of commercial receivers of this type when the satellite constellations become operational in 1995.

Mobile satellite communications capability for civil aviation is rapidly emerging. INMARSAT and its signatories, including COMSAT, are providing the requisite space segment for both data and voice communications worldwide. Initial avionics capability is available from a number of manufacturers. The FAA R&D program is cooperating with industry and the international community in the development of the necessary standards for exploiting satellite communications for aviation safety applications. We anticipate that satellite-based navigation and communications will revolutionize air traffic control practices in oceanic airspace and other areas with limited ATC capabilities over the next 10 years.

We are exploiting VHF data link communications to deliver departure clearances to airline aircraft. By the end of June, this capability will be installed at 30 airports nationwide. The service exploits existing airline industry communications and automation capabilities to reduce traffic delays and controller workload associated with clearance delivery at busy airports. The FAA's air traffic organization is considering the extension of this service to an additional 30 airports in the 1992 time frame.

Our development activities at Raleigh-Durham and Memphis have demonstrated that simultaneous independent operations on parallel runways spaced as closely as 3400 feet are feasible when high performance surveillance and traffic display systems are installed. Independent operation of these runway pairs provides 30 percent additional capacity as compared to the dependent staggered approaches used today when the runways are spaced less than 4500 feet. We are expediting the delivery of modified Mode S sensors for seven locations with closely spaced parallels. Installations will begin in 1994. In the meantime, the electronically scanned sensor at Raleigh-Durham will be upgraded to an operational status by January 1993. This sensor will be replaced with one of the Mode S sensors in 1996 to provide standard equipment for field maintenance purposes.

I hope that these few examples illustrate our commitment to timely, aggressive development and implementation of new ATC system capabilities to better meet user needs. We are learning how to be more responsive through joint ventures with industry, other government agencies, the airspace users, and the international community. We are learning how to expedite our system improvement efforts based on simulation and rapid prototyping activities, field evaluations of promising new technologies and procedures, and closer linkages between our R&D and implementation efforts. I am confident that we are on the road to success.

The National Airspace System in the 21st Century must be free from accidents due to human error. Today, almost 60 percent of all aviation accidents are caused by lapses in human attention or judgment. By the year 2000, we want to reduce this number by half to eventually eliminate all such errors.

Our recently published National Plan for Aviation Human Factors contains a detailed scientific and technical agenda for addressing the most significant human factors issues. The new R&D Plan will describe over 20 projects aimed at carrying out that agenda.

The introduction of new technology like cockpit displays, data link, and advanced automation will fundamentally change both aircraft operations and the role and type of expertise required of the flightcrew. The challenge is how to eliminate the dangers paradoxically created by the new safety and capacity enhancing technologies, as human operators must learn error-free ways to use our inventions.

We are continuing the pursuit of crashworthy aircraft with all fire-resistant cabin interiors. Our R&D efforts include studies to determine the causes of structural failures in airframes as well as analyses of the effects of lightning strikes, high intensity man-made electromagnetic fields, bird strikes, turbulence, and icing conditions. We are evaluating the structural airworthiness of aircraft constructed totally or partially with advanced materials as well as the effects of structure aging in terms of damage tolerance, corrosion, and fatigue. Other initiatives include composite airplane and commuter airplane impact testing; evaluating seat restraint systems; and analyzing improved designs for galleys, stowage compartments, and cabin interior furnishings.

We are investigating the effects of water impacts on the structural integrity of aircraft and the effectiveness of flotation devices to maintain the aircraft in an upright position thereby increasing passenger egress and survivability. Other initiatives are focused on the development of aircraft structures that can absorb severe impact loads and still maintain a habitable environment. In addition, we have an aggressive program to improve survivability during in-flight and post-crash fires.

Research and the regulations made possible by those efforts have vastly improved aircraft fire safety over the last five years. The FAA now requires cargo compartment liners to pass a stringent fire containment test. Aircraft seat cushions are now covered by fire blocking layers to delay flashover and provide more time to escape. Cabin interior surfaces must pass new, tougher tests for heat and smoke release. Lavatories must be equipped with smoke detectors and trash bins protected by automatic Halon extinguishers. Highly effective Halon 1211 hand extinguishers are required in the passenger cabin. Evacuation slides are now resistant to radiation produced by fuel fires, prolonging their usefulness.

Fire blocking seat cushions gave passengers more time to escape after the Delta 727 accident at Dallas/Ft. Worth Airport in 1988. Although the airplane was completely destroyed by fire following an aborted takeoff, 94 passengers and crewmembers out of a total of 108 survived.

Our latest fire test standard became effective this past March. It requires that all airliners in service have burnthrough-resistant cargo liners to control and contain in-flight fires originating in cargo compartments. The strategy is to isolate the rest of the airplane and its occupants from the fire.

Let me now briefly summarize the status of several of our current fire safety R&D projects which offer the potential for additional aircraft design improvements. I will begin with post-crash fire research. We've conducted seven full-scale fire tests in order to study and better understand how an external fuel fire burns through a fuselage shell and ignites the cabin interior materials. The most recent test simulated many of the factors present in the 1985 accident at Manchester, England. This coming year, we will begin evaluating promising methods and materials that may further protect the aluminum hull and cabin interior from burnthrough.

We have a high priority project to examine and develop a water spray system for inside the cabin. Extensive full scale tests, conducted in both narrow and wide body aircraft, indicate that a substantial 2 to 3 minute improvement in survival time is possible for various fire scenarios. We are estimating the potential benefits in terms of lives saved and evaluating service problems associated with an inadvertent discharge.

We have made notable progress in addressing in-flight aircraft fires and plan to continue this important research in Fiscal Year 1992.

Three projects that I would like to mention specifically are the Aircraft Command in Emergency Situations System, fire protection research in combination cargo compartments, and in-flight smoke venting.

Aircraft Command in Emergency Situations, or ACES, is basically a computerized fire detection system. It integrates warning signals from an array of fuselage fire detectors with state-of-the-art flight deck computers and displays. The broad objective is to display more timely and reliable information to the flightcrew during an in-flight fire or smoke emergency.

The specific goal is to shorten the time taken by the flightcrew to declare an emergency and land the aircraft. We have completed a feasibility study and a system design, and a prototype system is being fabricated. In 1992, we plan to conduct fire tests to demonstrate how the new system helps the flightcrew make the right decision faster.

Combination, or "combi" aircraft, have cargo compartments that share the main deck with the passenger cabin. Cargo fires in aircraft such as these may be particularly dangerous because it may be more difficult to protect passengers from the consequences. Last month, we began full-scale fire testing related to a number of issues, including fire detection, fire containment, and firefighting tactics for this category of aircraft.

The in-flight smoke venting project, as its name implies, is aimed at removing smoke from an airplane cabin during an in-flight fire. Under a cooperative research and development agreement, Adams-Rite Products, Inc. has fabricated a hand-operated smoke evacuation valve. The prototype was installed and tested on the agency's B-727 aircraft.

Although the Adams-Rite valve is not practical at this point for fleet-wide use, the tests resulted in important experimental findings on how to control smoke in an aircraft cabin. Our fire safety research and development program is focused on design changes that prevent fires from occurring, suppress fires and slow their spread when they do occur, and give passengers more time to escape.

The FAA is a key partner in this Nation's efforts to combat the threat of terrorism against civil aviation. There is, of course, no simple solution or single answer. Instead, the FAA relies on a multifaceted systems approach, constantly striving for improvements in procedures, human performance, and technology to meet a challenge that is both difficult and constantly changing.

As this Subcommittee knows, we are the leading government agency for research and development on explosive detection systems. The preponderance of our security R&D budget goes directly toward work on these concepts. The remaining portion focuses on weapons detection, security system integration in the airport environment, aircraft hardening, and human factors.

Currently, the most promising explosive detection system is based on the thermal neutron analysis, or TNA, technique. The FAA has purchased six TNA units and has been assessing their performance under operational conditions since September 1989. These units are operating at Dulles and JFK airports in the United States, and at Gatwick Airport in London, England.

Our efforts are not limited to a single explosives detection technology. We are working aggressively on a variety of other programs to identify and refine other technologies that will assist in the detection of explosives and explosive devices. This effort involves joint ventures with other government agencies, foreign authorities, U.S. aviation interests, and the scientific community, including the National Academy of Sciences.

The last research area that I would like to touch on deals with the efforts to reduce runway incursions. The tragic accidents in Los Angeles and Detroit, and the recent incident at Atlanta, highlight the need to combat the risk of surface collisions.

Careful analysis of runway incursions has given us substantial data which has enabled us to work systematically to address the problem. We have found that runway incursions are primarily caused by one or a combination of primary factors: errors in clearances; communications errors; ground navigation blunders; and lapses in awareness among flight crews and controllers. We recently issued a Runway Incursion Plan that identifies some 25 initiatives that we will undertake this year to address these concerns on a broad front. Each of these initiatives will add an additional measure of safety.

Technological improvements will focus on better in-pavement lighting systems; controller alerting devices; stop-bar testing; and the development of a low-cost airport surface radar system.

Technology improvements like these will have a profound effect on our approach to surface movement at an airport. But they are not the sole solution. People and procedures must be considered as well. Our Runway Incursion Plan covers the full spectrum of activities required to systematically reduce the threat.

Mr. Chairman, the initiatives I have discussed - the exploitation of satellite-based technologies; reliable aviation weather forecasts to assure the safety of flight and effective traffic management operations; automation improvements to increase system capacity and the safety and efficiency of flight operations; new surveillance systems to increase airport capacity; crashworthy aircraft with all fire-resistant cabin interiors; an aviation system secure in the face of terrorist threats; and the reduction, even elimination, of collisions on the airport surface - are managed, product-oriented undertakings, not paper exercises. And we pledge the effective use of those resources available to us to see that they are achieved.

Looking to the future, we will continue to rely heavily on the advice and counsel of the Research Advisory Committee established pursuant to the 1988 legislation. The Committee has been very important in structuring and reviewing our R&D plan and in formulating the vision of the future air traffic management system.

We have established a number of ad hoc subcommittees under the Advisory Committee to provide guidance and recommendations in a number of specific areas including human factors, noise abatement technology, transport aircraft safety, and runway incursions. In addition to sharing its collective knowledge, the Committee has provided the all important link to the aviation community.

Many of the Advisory Committee members have completed their two year terms and will be leaving soon. They take with them my deepest thanks and gratitude for their valuable contribution. When we first established the Committee, we needed to better formulate the core of the R&D program in order to focus on meeting user needs in the near to mid-term. With this behind us, we expect that the focus and membership of the Committee will shift to emphasize longer term research activities.

The recently authorized research grant program also provides an opportunity to concentrate on long-term R&D requirements. The FAA Technical Center has established a comprehensive structure and process to assure effective management of the grant program. Present plans are to have the initial grants in place by the end of this fiscal year. In the meantime, we are continuing our long-term support for Iowa State University (nondestructive inspection technology for aging aircraft), Sandia Laboratories (inspection systems for aging aircraft), and Wichita State University (crashworthiness).

Approximately one-half of our Fiscal Year 1992 budget request of $210 million will be used to carry out the programs I have just discussed and to improve our overall in-house capability. As you know, the success of our program depends on our ability to hire and retain a cadre of highly trained specialists in a variety of scientific, engineering, computer technology, and related disciplines. The skills of these personnel are essential both for the management and the implementation of technical programs and the infusion of state-of-the-art knowledge of rapidly changing technologies within the agency. In addition, since R&D programs may span 7 to 10 years, it is critical that the FAA expand its capability to track projects from inception to completion, that is, to develop and maintain an institutional memory. For Fiscal Year 1992 we have requested 38 new positions. We believe they are essential for the success of the program.

Our request for new positions is part of our commitment to building a research and development infrastructure with a world-class internal capability. Our current success is evident in FAA's quality new hires, utilization of Intergovernmental Personnel Agreements (reimbursable agreements to hire experts from academia, or non-profits, i.e., MITRE, Lincoln Laboratories, etc.), establishment of the Federally Funded Research and Development Center at MITRE, development of Centers of Excellence, and aggressive implementation of the research grant programs.

Mr. Chairman, I feel good about our many accomplishments over the past year and the direction and momentum of our progress. Some of our accomplishments have resulted in system improvements that are operational in the National Airspace System today, others will be fielded in the near future. We have a clear direction for the long-range development of the air traffic management system, and plan of attack on the current and foreseen security and safety issues in the aviation environment.

We have improved our internal management and control of the program and expanded the participation of the agency in formulating and guiding the program. We have the enthusiasm and support of the Research Advisory Committee and we are building our alliances among industry, airspace users, other government agencies, and the international community. And, importantly, we have had the support of this Subcommittee.

For that support as well as your helpful criticism, I would once again like to take the opportunity to personally thank you Mr. Chairman, Congressman Lewis, the other Members of the Subcommittee, and your professional staff. I look forward to working closely with you to continue our efforts to improve our R&D capabilities and to maintain this Nation's preeminence in aviation safety.

This concludes my prepared statement. Each of us would be pleased to answer any questions you may have.

Mr. VALENTINE. Thank you.
Mr. Colson.

STATEMENT OF FRANK J. COLSON, EXECUTIVE DIRECTOR, DOD POLICY BOARD ON FEDERAL AVIATION

Mr. COLSON. Mr. Chairman, members of the committee, thank you for the opportunity to provide the Department of Defense's views on the FAA's research, engineering, and development plan. I have provided a written statement which I would ask be entered into the record. Please let me briefly summarize the major points. I can assure you it will be brief, so your aide de camp will not have to be checked out on his machine.

Mr. VALENTINE. He's turned it over to me. If it goes off again, of course, it will not be as the result of a malfunction. [Laughter.]

Mr. COLSON. DOD has three major reasons why it is interested in FAA's R&D budget.

First, the Department of Defense is the largest single user of the NAS. Approximately 20 percent of the air traffic in the NAS are DOD aircraft. Without an efficient and effective air traffic control and airspace management system, our ability to train and exercise forces and to develop weapons systems and tactics would be severely inhibited. A vibrant R&D program by FAA is necessary to see that the NAS system keeps pace with all demands, both military and civil.

The second reason is that DOD is a large provider of air traffic control services in the NAS. In fact, DOD provides air traffic control services to over 20 percent of the Nation's aircraft, both military and civil. We look to FAA as the lead Federal agency for the development of air traffic control equipment, software, procedures, and standards. In many ways our capabilities as a provider are dependent upon FAA's development efforts. A vibrant RE&D program by FAA is necessary for both of us to advance our ability to serve the total aviation community.

In addition to being a major user of air traffic services and being a provider of air traffic services, there is a third reason why DOD is interested in FAA's RE&D budget. The health and vitality of the U.S. commercial air carrier industry in many ways is dependent upon a sound and efficient Air Traffic Control System and an airspace management system. Without the underpinnings of such an infrastructure, the growth of our airlines could be stagnated or inhibited. DOD relies upon a healthy commercial airline industry to provide DOD a mobilization base which is absolutely essential for the execution of national defense strategy and its rapid deployment and rapid reinforcement. During Desert Shield and Desert Storm we relied upon the commercial U.S. air carriers to provide airlift through the Civil Reserve Air Fleet, the CRAF program. Nearly 65 percent of the troops and 25 percent of the airlift cargo was moved to the Persian Gulf in civil aircraft. Between August 7th, 1990 and May 9th, 1991, our civil carriers flew over 4,800 missions to the Persian Gulf. We believe it is in the national defense interest to ensure the vitality of the ATC's infrastructure because without such an infrastructure, this very important mobilization resource—

our carrier industry—could be harmed. Without this industry we could not have executed Desert Shield deployments.

The good news is that with almost no warning, the commercial air carrier fleet and the Air Traffic Control System rose to the occasion and satisfied all of our demands, demands that were unprecedented in history.

DOD has been and continues to be consulted by FAA in the construction of both their RE&D plan and their capital investment plan. This close cooperation has resulted in a number of joint acquisition programs, such as the NEXRAD, the Next Generation Weather Radar program; and the FAA/Air Force Radar Replacement program, the FARR program. And, as you are aware, FAA is actively exploring, with our assistance and participation, uses for GPS within the NAS.

We believe a capable future aviation infrastucture is dependent upon current RE&D investment. Since our Nation can accept nothing less than such a system, DOD fully supports FAA's budget request. We find the budget request to be balanced and to have a clear vision of direction, as articulated in FAA's paper entitled "Concepts and Descriptions of the Future Air Traffic Management System of the United States."

Let me assure you, Mr. Chairman, that the Department of Defense is a willing and eager partner in any area in which we can contribute.

Thank you, Mr. Chairman, for the opportunity to make this statement, and I would be pleased to answer any questions.

[The prepared statement of Mr. Colson follows:]

DEPARTMENT OF DEFENSE

PRESENTATION TO THE COMMITTEE ON SCIENCE,

SPACE, AND TECHNOLOGY

SUBCOMMITTEE ON TECHNOLOGY AND COMPETITIVENESS

SUBJECT: VIEWS ON THE FAA RE&D PROGRAM

STATEMENT OF: MR. FRANK J. COLSON
EXECUTIVE DIRECTOR, DOD POLICY BOARD ON
FEDERAL AVIATION

MAY 1991

NOT FOR PUBLICATION UNTIL RELEASED
BY THE COMMITTEE ON SCIENCE, SPACE,
AND TECHNOLOGY, HOUSE OF REPRESENTATIVES

Mr. Chairman and Members of the Committee: I am Frank Colson, Executive Director of the DoD Policy Board on Federal Aviation. In this capacity, I am responsible for managing DoD's relationship with FAA on all matters including Air Traffic Control, Special Use Airspace and International Aviation. I am pleased to appear before you to provide the views of the Department of Defense (DoD) concerning the Federal Aviation Administration's Research, Engineering and Development plans in support of the FY 1993 Authorization request.

I am particularly pleased because the DoD has a vital interest in the progress and effectiveness of the FAA's RE&D program. DoD is both the largest user of the National Airspace System (NAS) as well as a major provider of air traffic services within the NAS. The DoD's aircraft account for approximately 20 percent of the air operations in the NAS and we provide air traffic control (ATC) services to over 20 percent of the nation's aircraft, military and civil. Additionally, the military services operate about 25 percent of the ATC facilities and navigational aids and have about 30 percent of the nation's air traffic controllers. We have also committed to modernize our terminal radar approach controls and associated equipment in concert with the FAA's NAS modernization program so that we can continue to provide equivalent and transparent services to all airspace users.

Throughout the development of the FAA's Capital Investment

Plan and the FAA's Plan for RE&D, the DoD has been consulted and provided comment on the direction and content of the plans. As intended by Congress in the FAA Act of 1958, DoD looks to FAA as the lead federal agency for the development of ATC equipment standards and procedures and to conduct the RE&D necessary to support these developments. I will focus my comments on the programs that most impact the DoD's ATC and flight operations.

The DoD is a full participant in the NAS modernization. A DoD Joint Program Office is in place to acquire the equipment required for DoD Radar Approach Controls (RAPCONs) to properly interface with the FAA's Area Control Facilities. To keep taxpayers expenses to a minimum, we rely on the FAA's RE&D initiatives and intend to work closely with FAA to jointly test and evaluate the FAA developed equipment and software. DoD is currently conducting a Cost and Operational Effectiveness Evaluation to determine what equipment is required for DoD facilities to maintain proper connectivity to FAA and provide transparent service to the users. A bi-agency memorandum is in place defining the affected facilities and, where operationally feasible, approach control responsibilities are being transferred to the FAA.

In addition to approach control modernization, the military is a partner in several other NAS programs. These include the Next Generation Weather Radar (NEXRAD), the Microwave Landing

System (MLS), the FAA/Air Force Radar Replacement (FARR) program, and several smaller but also important programs.

In addition to being a major user of ATC services and being a major provider of ATC services, there is a third reason why DoD is interested in FAA's RE&D budget. The health and vitality of the U.S. commercial carrier industry is, in many ways, dependent upon a sound and efficient national air traffic control and airspace management system. Without the underpinning of such an infrastructure, the growth of our airlines could be stagnated or inhibited. DoD relies upon a healthy commercial airline industry to provide DoD a mobilization base which is absolutely essential for the execution of the national defense strategy; that is, rapid deployment and rapid reinforcement.

During Desert Shield/Desert Storm we relied upon the commercial U.S. air carriers to provide airlift through the Civil Reserve Air Fleet (CRAF) Program. Nearly 65 percent of the troops and 25 percent of the airlift cargo was moved in civil aircraft. Between August 7, 1990 and May 9, 1991 our civil carriers flew over 4,854 missions to the Persian Gulf. We believe it is in the national defense interests to assure the vitality of the ATC infrastructure because without such an infrastructure, this very important mobilization resource, our air carrier industry, could be harmed. Without this industry, we could not have executed the Desert Shield deployments. On this point let me summarize by saying the good news is that with almost no warning the commercial air carrier fleet and air traffic system rose to the occasion. The exercise also identified areas, such as oceanic control and airspace/air traffic coordination that could be improved by more capable systems and equipment. Both of these areas are addressed by ongoing FAA programs, e.g., automatic dependent surveillance, Oceanic Display and Planning System (ODAPS), satellite communications and navigation, and new ground communications, as well as a joint initiative to establish a national air traffic services cell.

While pure research is important to keep the edge of technology moving forward, we believe ATC, by its operational nature, is an evolutionary business. The fundamental technology to take the nation into the 21st century is available today and being acquired. We believe the key to our future progress is applied research, development, and validation of concepts, procedures and standards. The R&D programs undertaken by FAA must strike a balance between the various competing demands and keep all aspects of the total system evolving together. We must seek a balance among hardware, software, procedures, standards and human factors. Through such a balanced program we believe a synergism will evolve and permit increased capacity within the airspace and airport confines and "...allow the FAA to seize the opportunities presented by modern technology" thus meeting the needs of all users from the general aviation pilot to the next generation high performance fighter aircraft.

The DoD strongly supports RE&D by the FAA for a full range of activities from the meat and potatoes safety and capacity initiatives to the future satellite based technology. Let me address a few of the RE&D areas where DoD will be following FAA work particularly closely.

Weather is the greatest cause of traffic delays within the system and all too frequently a cause of aircraft accidents. Fielding NEXRAD as well as the means of providing current weather information to the controller and pilot to make rapid and correct decisions is essential.

Aircraft and passenger safety also affects the military. With the pending phaseout of Halon for environmental reasons, it is essential that an effective replacement fire extinguishing agent be identified. Insuring the air worthiness of aging aircraft also affects the military. With constrained budget, older aircraft will remain in the inventory far longer than originally planned and we must insure our inspection methods detect potential problems. Conversely, composites are being used more extensively and their aging and stress characteristics must be understood.

FAA's security responsibilities are also important to the military. The ever present threat from terrorists require an effective intelligence dissemination capability as well as passenger and baggage screening. Airport physical security is also essential to the safety of the public. As events in the Persian Gulf have demonstrated, the world situation can change dramatically and rapidly. We can not allow our air industry to be held hostage to the threat of terrorism.

Satellite navigation and communications is the final RE&D area I would like to emphasize. Both are essential to the future effectiveness of military operations and command and control. They could also form the basis for automatic dependent surveillance, improved use of oceanic airspace, and more direct routings for NAS users. Within the next four years, the Global Positioning System (GPS) will be fully operational. Avionics will be installed on many military aircraft with an eventual goal of replacing the military non-precision navigation aid receivers. The DoD and FAA are developing the standards for enroute positioning accuracy, instrument approach procedures for GPS, and with NASA Ames at Crow's Landing, exploring the possibilities of using differential GPS for even greater navigation accuracies. Although a military system, the DoD is cooperating with the FAA the International Civil Aviation Organization, and the Soviet Union to develop criteria and equipment for satellite based navigation and determining its availability for the civil user.

A strong transportation infrastructure has been a major factor in the economic development of the United States and its industries. Our future is tied to the strength and capacity of the NAS. Strong aviation and air traffic R&D programs with timely implementation of effective and synergistic systems is essential. The FAA's leadership and foresight as displayed by the FAA's recently released "Concepts and Description of the Future Air Traffic Management System for the United States" must continue. The DoD is committed as a willing and productive partner in this process in order to insure both a strong economy and national defense.

Thank you, Mr. Chairman, for the opportunity to make this statement. I will be happy to answer your questions.

Mr. **Valentine**. Thank you, sir. We thank both of you.

Mr. Del Balzo, you have outlined here a very ambitious plan, and I recognize the fact that you would have supplied more detail, but it is difficult to do that when somebody is saying, "Cut it short, cut it short." So we are going to give you, I think perhaps with the questions, an opportunity to expand and emphasize some of the things that are in your prepared statement.

You have outlined what is admittedly a very, very ambitious plan. Do you believe that it can be implemented with that $210 million which you request?

Mr. **Del Balzo**. The approach we took this year to develop our R&D plan was an unconstrained approach. In the past what we have done is we have assumed a budget level, and we have built the program, constrained to that budget level.

What we did this year was, we built an unconstrained program, looking at what it is that is required, consistent with the goals and vision of an aviation system for tomorrow. When one looks at that plan, the question then is, how much is it worth? What kind of an investment are we talking about?

I don't know the answer to that question. What I do know is that if one were to assume that research and development in aviation is worth 5 percent of an agency's budget, one could be talking about upwards of $350 million to start with. Five percent, I believe, is conservative by average industry standards.

I think it is for this committee, I think it is for FAA, I think it is certainly for the Administration to debate and decide how much of an investment we're prepared to make in an aggressive R&D program. If you were to ask me, do we have enough, the answer is always no. Would you like more? The answer will always be yes. The real question is, how much are we prepared to invest in carrying out an unconstrained program? How quickly do we want to get things done? I think that's a debate that still has to take place.

Mr. **Valentine**. You have indicated confidence, of course, in the R&D plan. To the extent that you haven't already done so, could you just tell us briefly how it was designed?

Mr. **Del Balzo**. As I said, it was not designed by FAA people in a vacuum. We didn't lock ourselves up in a closed room and decide what an R&D plan should look like. What we did was two things. We first involved all of FAA, our internal users, and we developed some guidance with the users. We brought in external people from the user community. And together, over a four-week period, we produced a plan that has two things. One, it is comprehensive; it's unconstrained; it has the support of the internal customers within FAA, our air traffic organization, our flight standards organization, and our airway facilities organization.

Secondly, I believe you will find it has the full support of the user community. That's what's different about this R&D plan.

[Bell rings.]

Mr. **Valentine**. Make an entry in the record that nobody up here knows how to operate this thing. [Laughter.]

You have talked to us, as you should, about good news and about bad news. When can we expect some of the results from this new R&D effort and renewed vigor which you have described? When can we expect that to be translated into a good news report to this committee?

Mr. **Del Balzo**. I think a year from now, when I come back, I would hope to give you a good news report with no bad news. What I shared with you today was the good news and the bad news. What we have in an R&D plan this year provides the groundwork for us to come back next year with all good news.

Mr. **Valentine**. Can you tell us what the FAA has done to improve their engineering depth and general research capability?

Mr. **Del Balzo**. I think we've done several things, Mr. Chairman. We have in fact, over the past 12 months, hired 50 people into the R&D organization, both in Washington and our research facility in Atlantic City. It's one of the numbers that are somewhat impressive. But secondly, and more important, the qualifications of the people we have hired are extremely impressive. I think when one looks at the mix of people, there are at least a dozen people that I would testify to you are world-class. We have complimented those people with people who are on assignment to us from other organizations, from universities and from our R&DC. They are on two-year assignments, world-class people.

We have established the federally-funded Research and Development Center, again, with your support, and that in itself is an extension of our own in-house capability. We are now positioned to further increase our in-house capability, an extension of our in-house capability, through the Centers of Excellence program. So I think we have in fact done well in terms of establishing an internal capability.

Mr. **Valentine**. Has the situation improved with respect to the training of air controllers? There was a time when it seemed that it took about as long to train and to produce a controller than it did to produce a lawyer—I might say that, perhaps, with more good for humanity with controllers than with the others. At one time it seemed to me, and perhaps still is, a very lengthy process that almost defied comprehension, the way the process was required, almost one- on-one training and internships. Can you talk to us a little bit about that and that situation?

Mr. **Del Balzo**. Yes. I think in the past we have had an air traffic controller recruitment and development training program that we would all agree took a very long time, that in fact was very expensive, and in the eyes of many not very efficient, and in the eyes of some, almost inhumane.

I think we are on the verge of what I think is a major revolution in how we recruit and train air traffic controllers. Instead of a laborious training program at our own aeronautical center, where the past rate has not been very good and it has in fact taken a long time, we have with our medical folks, the medical research and development folks in Oklahoma City, developed what we believe is a screening process for air traffic controllers based upon aptitude that I believe can now be accomplished in one week instead of four months. Given that a person passes that aptitude test, he is prepared to move into an academic environment, out of an academic environment, and into the facility for hands-on training in probably two to three months' time. I think we're on the verge of a major breakthrough. There is some validation that has to be done;

we are doing some correlation exercises now. Between people who take this new exam and the old exam, I think within six to twelve months we will have good news.

Mr. VALENTINE. Thank you, sir.

The Chair notes that our colleague, Congressman Hughes, has arrived.

If you will come around, Congressman, we will hear from you now. If you will just take a seat over here, if you will just pull that microphone up there.

We are very happy to have with us today to present his testimony a most distinguished and senior Member of Congress, the Honorable William Hughes from the State of New Jersey.

Welcome, sir.

STATEMENT OF HON. WILLIAM J. HUGHES, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF NEW JERSEY

Mr. HUGHES. Thank you very much, Mr. Chairman. I am just delighted to appear before this distinguished Subcommittee on Technology and Competitiveness.

I would like to thank the committee for giving me the opportunity to appear before you for this Federal Aviation Administration research and development oversight hearing.

The Federal Aviation Administration has a mammoth and critically important mission, as you well know. Ensuring the safety of our Nation's civil aviation system is an enormously complex and challenging assignment. To meet the demands presented by rapidly evolving and advancing technology, it is essential that the FAA be at the forefront of aviation-related research and development.

In recognition of this requirement, Congress provided the FAA with new resources to become even more involved in basic and applied research. Public Law 101-508 authorized $260 million for FAA's research and development program, and other measures have given the FAA new flexibility and additional capabilities for fulfillment of its mission.

However, there is growing concern the FAA is not making sufficient progress, despite this dramatic increase in funding and the additional resources recently made available for these purposes.

This Nation's increasingly crowded airspace, our aging aircraft fleet, the intensely competitive nature of commercial aviation, the problems that have been experienced with our Air Traffic Control System, security concerns, and other difficulties have placed a tremendous strain on civil aviation in this country, and the loss of public confidence is a very real prospect.

It is imperative that the FAA play a very strong and visible leadership role in addressing these concerns. The FAA must move quickly and effectively to develop new equipment, systems, policies, and procedures to resolve such problems and to restore faith in the system.

Given the magnitude of this problem and the concerns that have developed over the pace of progress, it is appropriate to reexamine—as this subcommittee is doing—the FAA's performance, particularly with regard to its research and development program. I applaud this committee for its interest in bringing this issue to the fore so we can seek ways to improve delivery of these vital services.

The FAA's research and development and test and evaluation program is of tremendous interest to me personally. The Federal Aviation Administration's Technical Center is located in my district.

For those who may not be familiar with the Technical Center, this facility is located 10 miles northwest of Atlantic City. It covers some 5,000 acres and includes the Atlantic City International Airport, the only airport still owned by the FAA. In fact our colleague, Joe Del Balzo, was one of the distinguished directors of the FAA many years ago, and advanced many of the missions there under his stewardship.

In addition to the airport with its new control tower and extensive runway system, the Technical Center includes a 516,000-square-foot laboratory building which houses an air traffic simulation facility and three air traffic control laboratories. There are a number of smaller laboratories located on the site performing leading work on aviation security and explosives detection, aging aircraft and structural safety, fire safety, crashworthiness, and other vital programs.

The Technical Center is the site for development, test, and evaluation of the multi-billion dollar National Airspace Systems Program, and a new 175,000-square-foot Advanced Automation Systems Laboratory will soon be constructed on site by IBM for pursuit of that particular project.

The State of New Jersey has recognized the importance of the Technical Center and this airport. With the cooperation of the FAA, an effort is now underway in the New Jersey Legislature to create a new regional transportation authority to promote expansion of the Atlantic City International Airport, and the State is developing a new high technology-oriented research park adjacent to the Technical Center to provide locations for the many businesses and contractors involved in FAA research and development programs.

The FAA's Technical Center currently provides work for more than 2,000 extremely talented Government and private sector scientists and technicians, and that number is expected to increase dramatically in the coming years as new facilities are constructed and new projects initiated.

Despite the foregoing, and in acknowledgment of the concerns to be considered this morning, I would agree that some fundamental changes may be necessary in the way FAA conducts business so we can be assured of prompt and practical results. What is lacking, in my opinion, is the long-term and strong commitment to basic and applied research which is urgently required if we are to attain dramatic breakthroughs and achieve sustained progress.

While the FAA must retain the flexibility and capacity required to respond immediately to emergency situations, it must also develop a firm foundation upon which it can build the civil aviation system of the future. The FAA must be willing to invest in the kind of facilities, programs, and people necessary to solve the tough problems and to keep the United States at the forefront of advances in aviation sciences.

As I indicated earlier, at its Technical Center in New Jersey the FAA already, to a large extent, has the people and the resources required to perform its research and development mission effectively and efficiently. However, if the concerns of this committee are to be addressed, and if the Technical Center is to secure its rightful place as the preeminent aviation research and development center in the United States, some changes in FAA philosophy and operations are necessary, in my judgment.

There has been a tendency on the part of some in FAA to downplay the Technical Center and the significance of both the test and evaluation and research and development work which is carried out there.

I might say parenthetically that Joe Del Balzo knows it very well, and we have seen major progress in the last couple of years in recognizing the tremendous potential at that Technical Center. That hasn't always been the case.

While that attitude may have been somewhat justified years ago, that is hardly the situation today, as I have indicated. The Technical Center has the facilities and people who are now performing leading research and development. What is needed is broader recognition of this fact by FAA, and a greater effort by FAA to ensure that the Technical Center is assigned the kind of work it is capable of performing, and to rely less on private laboratories and contractors.

One way to achieve the objective stated above would be for the FAA to consider assigning the Technical Center its own line item appropriation within the budget. This would help ensure adequate funding and introduce long-term stability to the vital research programs being pursued at the Technical Center. It could also serve to elevate the importance of the Technical Center within the FAA's administrative structure, and give it a certain level of independence and autonomy so it will be more free to pursue its important mission.

The FAA must also give adequate consideration to the Technical Center when new facilities and programs are to be initiated. For example, the FAA is planning the development of a new National Simulation Laboratory which will be used to simulate advanced air traffic control concepts to shape the next generation of air traffic control technology.

The National Simulation Laboratory will be a vital part of FAA's ongoing research, development, and engineering process as it designs aviation systems for the future. With the full range of complementary and supportive facilities and trained personnel already in place at the Technical Center, the National Simulation Laboratory would be a logical addition to the outstanding array of services and capabilities that comprise the Technical Center.

I share some of the concerns of this subcommittee regarding the FAA's research and development program. However, in this age of technological sophistication, I see no need for us to reinvent the wheel as we seek solutions to these problems.

I believe many of the answers lie in simply making better use of existing facilities, programs, and resources. There exists at places like the FAA's Technical Center a great wealth of talent, expertise, and equipment which, if given sufficient support, can be relied upon to bring the civil aviation system of the United States to a safer and even more successful future.

Let me just say before closing, Mr. Chairman, that I have seen roller coaster funding for many of the missions at the Technical Center in the last few years. The A-76 review process has taken its toll. It was used as a way to reduce the Federal workforce. It destroyed morale. I've seen years when the Technical Center could not replace many of the scientists that they saw leaving through attrition. We did see some losses.

I think that is behind us. I see morale being rebuilt. I see a new spirit in existence. It's a small community; it's an important one, but it's a small, important technical community.

So I see these folks that work there almost on a weekly basis. I'm back home every week, and I've seen some changes in the past year, and they're for the better. I think we can further strengthen these important missions by providing the resources on a steady basis and attempting to build the in-house expertise. We destroyed that, not just at the Technical Center, for a while, but at other facilities, where I saw us, with the A-76 contracting out process, destroy that in-house capability. There is an important role for contracting out, but I think we have to be careful that we don't destroy our in-house capability. We're rebuilding right now, and I think we'll see some major strides in the years ahead in that facility. I consider the Technical Center as second to none, and that's not just because it's in my district. I've seen it grow over the years. I've seen its problems. We've fought the problems. I think we now recognize some of the shortcomings. I'm happy to say that under Joe Del Balzo's leadership we have seen some major strides take place, because he knows the Technical Center, he knows its capability, and I think you're going to see some tremendously important initiatives come out of the Technical Center in the next few years that will address many of the problems we all share.

Thank you.

[The prepared statement of Mr. Hughes follows:]

STATEMENT BY THE HONORABLE WILLIAM J. HUGHES, M.C., BEFORE THE HOUSE SUBCOMMITTEE ON TECHNOLOGY AND COMPERITIVENESS, MAY 16, 1991

Good morning. I am Congressman Bill Hughes representing New Jersey's Second Congressional District, I would like to thank the Subcommittee on Technology and Competitiveness for giving me this opportunity to appear before you for this Federal Aviation Administration Research and Development oversight hearing.

The Federal Aviation Administration has a mammoth and critically important mission. Ensuring the safety of our nation's civil aviation system is an enormously complex and challenging assignment. To meet the demands presented by rapidly evolving and advancing technology, it is essential that the FAA be at the forefront of aviation related research and development.

In recognition of this requirement, Congress provided the FAA with new resources to become even more involved in basic and applied research. Public Law 101-508 authorized $260 million dollars for FAA's research and development program, and other measures have given the FAA new flexibility and additional capabilities for the fulfillment of its mission.

However, there is growing concern the FAA is not making sufficient progress, despite this dramatic increase in funding and the additional resources recently made available for this purpose.

This nation's increasingly crowded airspace, our aging aircraft fleet, the intensely competitive nature of commercial aviation, the problems that have been experienced with our air traffic control system, security concerns and other difficulties have placed a tremendous strain on civil aviation in the United States, and the loss of public confidence is a very real prospect.

It is imperative that the FAA play a very strong and visible leadership role in addressing these concerns. The FAA must move quickly and effectively to develop new equipment, systems, policies and procedures to resolve such problems and to restore faith in the system.

Given the magnitude of this problem and the concerns that have developed over the pace of progress, it is appropriate to reexamine the FAA's performance, particularly with regard to its research and development program. I applaud this committee for its interest in bringing this issue to the fore so we can seek ways to improve delivery of these vital services.

The FAA's research and development and test and evaluation program is of great interest to me. The Federal Aviation Administration's Technical Center is located in my district.

For those who may not be familiar with the Technical Center, this facility is located 10 miles northwest of Atlantic City. It covers some five thousand acres and includes the Atlantic City International Airport, the only airport still owned by the FAA.

In addition to the airport with its new control tower and extensive runway system, the Technical Center includes a 516,000-square foot laboratory building which houses an Air Traffic Simulation Facility and three Air Traffic Control Laboratories. There are a number of smaller laboratories located on the site performing leading work on aviation security and explosives detection, aging aircraft and structural safety, fire safety, crashworthiness, and other vital programs.

The Technical Center is the site for development, test and evaluation of the multi-billion dollar National Airspace Systems Program, and a new 175,000-square foot Advanced Automation Systems Laboratory will soon be constructed on site by IBM for pursuit of that project.

The State of New Jersey has recognized the importance of the Technical Center and this airport. With the cooperation of the FAA, an effort is now underway in the New Jersey Legislature to create a new regional transportation authority to promote expansion of the Atlantic City International Airport, and the State is developing a new high technology-oriented research park adjacent to the Technical Center to provide locations for the many businesses and contractors involved in FAA research and development programs.

The FAA's Technical Center currently provides work for more than 2,000 extremely talented government and private sector scientists and technicians, and that number is expected to increase dramatically in the coming years as new facilities are constructed and new projects initiated.

Despite the foregoing, and in acknowledgment of the concerns to be considered this morning, I would agree that some fundamental changes may be necessary in the way FAA conducts business so we can be assured of prompt and practical results.

What is lacking, in my opinion, is the long term and strong commitment to basic and applied research which is urgently required if we are to attain dramatic breakthroughs and achieve sustained progress.

While the FAA must retain the flexibility and capacity required to respond immediately to emergency situations, it must also develop a firm foundation upon which it can build the civil aviation system of the future.

The FAA must be willing to invest in the kind of facilities, programs and people necessary to solve the tough problems and to keep the United States at the forefront of advances in aviation sciences.

As I indicated earlier, at its Technical Center in New Jersey, the FAA already, to a large extent, has the people and the resources required to perform its research and development mission effectively and efficiently.

However, if the concerns of this committee are to be addressed, and if the Technical Center is to secure its rightful place as the preeminent aviation research and development center in the United States, some changes in FAA philosophy and operations are necessary.

There has been a tendency on the part of some in FAA to downplay the Technical Center and the significance of both the test and evaluation and research and development work which is carried out there.

While that attitude may have been somewhat justified years ago, that is hardly the situation today. The Technical Center has the facilities and people who are now performing leading research and development. What is needed is broader recognition of this fact by FAA, and a greater effort by FAA to ensure that the Technical Center is assigned the kind of work it is capable of performing and to rely less on private laboratories and contractors.

One way to achieve the objective stated above would be for the FAA to consider assigning the Technical Center its own line item appropriation within its budget. This would help ensure adequate funding and introduce long-term stability to the vital research programs being pursued at the Technical Center. It could also serve to elevate the importance of the Technical Center within the FAA's administrative structure, and give it a certain level of independence and autonomy so it will be more free to pursue its important mission.

The FAA must also give adequate consideration to the Technical Center when new facilities and programs are to be initiated. For example, the FAA is planning the development of a new National Simulation Laboratory which will be used to simulate advanced air traffic control concepts to shape the next generation of air traffic control technology.

The National Simulation Laboratory will be a vital part of FAA's ongoing research, development and engineering process as it designs aviation systems for the future. With the full range of complementary and supportive facilities and trained personnel already in place at the Technical Center, the National Simulation Laboratory would be a logical addition to the outstanding array of services and capabilities that comprise the Technical Center.

I share some of the concerns of this Subcommittee regarding the FAA's research and development program. However, in this age of technological sophistication, I see no need for us to reinvent the wheel as we seek solutions to these problems.

I believe many of the answers lie in simply making better use of existing facilities, programs and resources. There exists at places like the FAA's Technical Center a great wealth of talent, expertise and equipment which, if given sufficient support, can be relied upon to bring the civil aviation system of the United States to a safer and ever more successful future.

Thank you very much.

# # #

Mr. Valentine. Thank you, Mr. Hughes. We appreciate very much your taking the time to come and share these words with us.

I, as most members of the subcommittee, have visited that facility. It is indeed impressive.

Do any members of the subcommittee have any questions? Mr. Lewis, do you have any questions?

Mr. Lewis. I want to compliment the gentleman on this testimony. I think he raised some points that I will be raising to Mr. Del Balzo.

Some of the statements you've made, particularly about the technical assistance, we certainly need to address more fully in this subcommittee.

Thank you.

Mr. Valentine. The Chair will recognize Mr. Rohrabacher, who entered as the gentleman from New Jersey was completing his remarks.

Do you have any questions?

Mr. Rohrabacher. I apologize for being late. Being a Congressman, you have to go to three or four different meetings at one time, and they're all important.

I will read your testimony, and I apologize for being here late. I will read your testimony and look over the hearing record. Thank you very much.

Mr. Valentine. If you would read the statement, please, and sign it and have that verified and submitted to the chairman, please. [Laughter.]

Thank you very much, sir.

Mr. Hughes. Thank you very much, Mr. Chairman.

Mr. Valentine. Thank you, sir.

We will return to Mr. Del Balzo. I have a comment and one final question of Mr. Del Balzo.

You made a statement about the responsibility of the subcommittee which I thought showed great understanding and indicated a spirit of cooperation. We have been accused of trying to micromanage, Congress as a whole that is. I don't think this subcommittee, or the committee has micromanaged to that extent. We would welcome an opportunity to formulate a plan whereby we, this subcommittee, could have more than this yearly contact. We will seek ways through staff and directly, and I would invite advice from you to me and to other members of the subcommittee, as to how to go about that.

My question on that is, Do you think it would serve a useful purpose—I know that it takes time to prepare testimony and an effort to come here—if we undertook to have more than one hearing of this kind in a 12-month period?

Mr. Del Balzo. I think that's one of several ways that we could increase the communication. Yes, it does take time. I would support that, yes, sir.

Mr. Valentine. I think that the effort to communicate serves a lot of purposes. We could have meetings at your place or ours, private meetings, but there is another facet, of course, to this type of discussion. We have an opportunity to make public, or to air, problems that we perceive and that, indeed, you might see.

The FAA has said that they see a potential in tilt-rotor technology—of course, to help resolve air traffic problems. Does this interest, do you think, warrant further enquiry by the subcommittee into that? Should we have a hearing just to look into that specific area?

Mr. DEL BALZO. I think the subject of tilt-rotor technology and its application in a civil environment warrants some critical attention. I think this committee knows that we have sponsored several studies about the benefits of tilt-rotor technology in civil aviation. Here is what we have concluded.

We have concluded that, one, there is a market. But, two, manufacturers are not willing to take a risk and make the capital investment to develop a civil version of the tilt-rotor unless there are orders placed. And the losers, the air carriers, are not willing to place orders unless they are convinced that the vehicle will be economical to operate and maintain, that its noise will be acceptable in the community, that vertiports can in fact be built in downtown city areas, and that passenger acceptance is for real.

What you find is city planners not being willing to build vertiports without users and without guidance from FAA as to the size of the vertiports, and what you find from FAA is a reluctance to provide criteria on design of vertiports without knowing the vehicle characteristics. Do we build a vertiport based upon the 15 degree descent profile? Or do we build a vertiport based upon a 7 degree descent profile? Depending on what you choose, the size of the vertiport will increase or decrease. We don't want to provide that kind of guidance because we are afraid that if we did, we would provide guidance that would result in performance of a vehicle that would not be economical, and at the same time, there has to be an infrastructure in place, an Air Traffic Control System infrastructure.

So it's "chicken and egg," but in this case I believe what comes first is all of them, all of the things I have mentioned have to occur at the same time. And I don't think anyone is smart enough to know how to do that. But I believe that somehow we have to marshal a Government/industry partnership at the Federal and local levels, with the manufacturers and with the users. We don't know what that partnership looks like, either, but I know that without a partnership that will allow all of these things to occur at the same time, somebody else will beat us to the marketplace.

It is a subject that I feel passionate about. I was in Phoenix last week, and I am now convinced that a company by the name of Ishida is going to build a production version of what they call a tilt-wing, not a tilt-rotor, and they will have that vehicle flying and in the marketplace by 1994. It's not a question of will the civil tilt-rotor be built, it's a question of who is going to build it, us or somebody else. Does it need attention? I think it does.

Mr. VALENTINE. Speaking of "somebody else," what is the state of development of this technology in, say, Japan or Germany, elsewhere?

Mr. DEL BALZO. I think what you will find are three things that are going on. You find Japan financing the building of the tilt-wing. They have a plant located in Alliance Airport in Texas, and that's Ishida, and that vehicle will be flying in 1994. It's a nine-passenger version that is a business version of a tilt-wing.

What you find in Europe is a consortium called Eurofar. They are committed to beating the United States to the marketplace with a production vehicle. That's what I see happening internationally.

Mr. **Valentine**. If necessity has anything to do with invention, it seems that the Japanese would have a desperate need for this type of technology——

Mr. **Del Balzo**. Oh, no question about it.

Mr. **Valentine** [continuing]. Because of the topography and the size of the entry.

Did you bring this inverted piano in here? Could you tell us what this is?

Mr. **Del Balzo**. I was wondering if anyone would ask what that is.

Mr. **Valentine**. Well, frankly, I wasn't here when it was transported into the room. I thought it was something that some staff member had concocted. I thought it was part of the fixture over there, maybe like the heating and the air conditioning. But if you did bring it in here, we await a description of what it's for with fear and trembling.

Mr. **Del Balzo**. What that is, is one of many new initiatives that you will find in this R&D plan that I talk about. This is part of a research and development program associated with runway incursions. What you're looking at is a large version of a bar code, a bar code that you will find on many grocery products, and that bar code is intended to be put on an aircraft, to be read by lasers that would be located along the edge of runways and taxiways, that would monitor and identify, one, the location of the aircraft and the identification of the aircraft, and via datalink, pass that information on to the air traffic control tower.

Will it work? I don't know if it's going to work, but it's another research initiative that was developed by our Runway Incursion Program manager, Mike Harrison, who is with us today. I think that's an example of a research program on runway incursions, one, that is comprehensive, and two, is not a research program that belongs to me; it belongs to FAA. So Mike Harrison is a research program manager on runway incursions, and he speaks for FAA on the subject of runway incursions.

One of the things that we have done is, we have made the link between research and development and implementation through what we call not "research program managers," but "FAA program managers" that are responsible not just for the research, but in this case, Mr. Harrison is responsible also for the implementation of products that come out of the research activity.

Mr. **Valentine**. He was hidden from us by the keyboard when you introduced him. Would you introduce him again and ask him to stand?

Mr. Harrison.

Now, we understand that this invention, this system, was developed entirely by an in-house arrangement at FAA?

Mr. **Del Balzo**. No, just the opposite. One of the things that we pride ourselves on now is recognizing good ideas from somebody else when we hear them, and in doing something with them. Mike Harrison will tell you that this was not our idea. This idea comes to us from a university, and that's what we are pursuing. We will pursue this idea jointly with the university.

Mr. Valentine. All right. We will come back to that.

I am using a lot of time, but let me ask Mr. Colson one question.

After the tragic Flight 107 accident, it's our recollection that President Reagan promised international use of NAVSTAR. Could you tell us what is the status of the delivery on that promise, and how FAA and DOD are working to make NAVSTAR available to international aviation?

Mr. Colson. Yes, sir. Thank you.

Your recollection is excellent. On September 16 there was a statement read by the President of the United States which read, "World opinion"—and this was after the 007 shoot-down, as you mentioned—"World opinion is united in its determination that this awful tragedy must not be repeated. As a contribution to the achievement of this objective, the President has determined that the United States is prepared to make available to civilian aircraft facilities the Global Positioning System when it becomes operational. This system will provide civilian airlines three-dimensional positional information."

That was the statement of our position and it continues to be. We have steadfastly worked toward that objective. This year's 1990 version of the Federal Radio Navigation Plan provides a complete description of the Global Positioning System and its potential uses in civil aviation. We are working closely with FAA on a number of R&D demonstration programs to demonstrate the use of GPS in the terminal area, both using differential and without use of differential, and we continue to work very closely with FAA in development of the procedures that will allow the GPS to be used for en route navigation.

Mr. Valentine. Thank you, sir.

The Chair recognizes the distinguished ranking member of the subcommittee, Mr. Lewis.

Mr. Lewis. Thank you, Mr. Chairman.

Mr. Del Balzo, your testimony was very interesting this morning, as well as that of Mr. Colson and Mr. Hughes.

I would like to summarize your statement from my perspective. In aviation safety, FAA has a good research program in tombstone technology, because all of the research—or almost all that you discussed—was started because of an accident.

What is not in your statement is a long-term research program to detect problems before they become accidents, working toward that goal.

Mr. Del Balzo, I said in a public meeting with about a thousand people about a year ago and I said several times before this committee, that I think you're one of the greatest things that ever happened to FAA, and I still maintain that. And if I was the Administrator and was asked to come before a subcommittee, I would send you, like he did, because we have a lot of respect for you.

But I have to ask some questions today that you may or may not want to answer. I've looked at the program that you have come out with, the plan, and I don't see any long-term research commitments in there for fire safety. I would like to point out what the law specifies, that the committee has disagreed—this is the report of the committee—that we disagree with what you're doing in fire safety, and it shouldn't be halted when improvements appear to be difficult or time-consuming to achieve; that FAA should work toward a goal of total fire resistance.

The time to make a most effective determination is when improvements are known, not before research is conducted to develop it.

I could go through this, and I have a lot of things highlighted, but I don't want to take a lot of time in doing that. But there are a number of things that I am disturbed about. I have been to Atlantic City, as you know. I know many people here are from the FAA. I recognize some of the faces from the Research Center in Atlantic City, and I know the job that you're doing. But I don't think we asked for stopgap measures. I think we've asked for information over the last three to four years about budget information. I received a letter from the Administrator just the other day that said this subcommittee would receive that after it goes to the Appropriations Committee; however, this is the authorizing committee. We've asked for information as to how the money has been spent in research and development—not so much, Mr. Del Balzo, that we want to criticize you for spending money, but maybe criticize you for not asking for enough or being forceful enough before this subcommittee that you need these funds.

I have seen that lacking throughout your agency coming before this committee, saying what you have to do and what you have to have to improve flight safety. I have not seen that happen, and I have sat on this committee now almost eight years.

We agree that you should spend most of your R&D resources on immediate problems. I don't think we disagree with you at all. But we also feel that the long-term goals have been absolutely ignored. We added the impetus by allowing 15 percent of your research budget for these programs. We set up in the law a budget request that asked for a 15-year plan, with greater detail in the first two years. I think you've done the two-year portion of that. We asked you to set up a review committee, which you have done, but in the law it states that the committee will be set up with not only people from the industry, not only people from general businesses, but also consumers.

Now, I recognize that everybody on that committee on that committee uses commercial aircraft and can be called a consumer, but I believe somebody like Mr. Joe Lunchbucket or somebody like that, walking around out there, should be on that committee, as well, and absolutely be able to determine and show the committee exactly what the problems are with white-knuckle fliers and people that don't have the ability to get their statements before the public.

Now, Public Law 100-591 mandates that the Administrator of the Federal Aviation Administration undertake or supervise research on the following:

To assess the fire and smoke resistance of aircraft materials;

To develop and improve fire and smoke containment systems for in-flight fires; and

Develop advanced aircraft fuels with low flammability and technologies for containment of aircraft fuels for the purpose of minimizing post-crash fire hazards.

I'd just like to point out a couple of things.

The regulatory situation that we have requires you to go through the Federal Register, as you do, and place forward rules and regulations that you want to apply. But the time frames on these are absolutely abominable, when the airlines have to meet these requirements. I certainly have a problem understanding that, and you and I have discussed this in the past.

When we take into consideration that we had this accident where the DC-9's engine was ripped off—and I know when I was at the station in Atlantic City, I discussed with the people up there fuel containment, and you had one small program going on—I mentioned the naval system that they have for fuel containment. Though it's not the best, they are still researching it and trying to make it better. Nobody seemed to be interested in this. I sincerely believe if that type of system had been on that DC-9, the chances of fire would have been very well minimized and we probably could have saved some lives.

I heard you mention in your testimony about the type of people, and also in response to the question of the chairman, about the engineers and scientists. I would like this committee to receive from you the numbers of engineers and scientists and technicians that you have hired under the research act in order to do this long-term research and development. And I would like it, Mr. Del Balzo, provided to this committee within 72 hours, or we'll have to go to the GAO and get it.

Now, I'm saying that for a reason, because I'm going to name a number of things that we have asked FAA to provide this subcommittee since early 1990 that we have not received, and we were told it would be given to us. I am concerned about that, because I think we're looking at—and I know this is sounding like a speech, but I am ventilating as well—that we are more interested in building our bureaucracy at the FAA than we are in providing the necessary personnel with the tools in order to get some of the short-term answers, as well as work on the long-term answers and goals. I think that you and I and most everybody in this room wants to make sure that every time you get on an airplane, you're going to get off in a safe manner. I think that's what we all want, but, by golly, sometimes I don't think we're really shooting for that. We'll accept the statistics as they go.

[The information follows:]

U.S. Department
of Transportation
**Federal Aviation
Administration**

800 Independence Ave., S.W.
Washington, D.C. 20591

May 21, 1991

The Honorable Tim Valentine
Chairman, Subcommittee on Technology
  and Competitiveness
Committee on Science, Space, and Technology
House of Representatives
Washington, D.C. 20515

Dear Chairman Valentine:

In compliance with your request at the May 16 hearing before the House Subcommittee on Technology and Competitiveness regarding the number of engineers and scientists recently hired by the Federal Aviation Administration (FAA), we submit the enclosed personnel summary. It demonstrates our efforts to lessen agency reliance on private contractors and facilities by bolstering human resource levels in highly technological disciplines.

The list details each new employee by position title, in conjunction with corresponding grade and educational level, and groups staff according to assigned research and development component. Included also is the area of concentration pertinent to an employee's duties and responsibilities.

As I indicated during the hearing, we have made a commitment to strengthen FAA's long-term research efforts by building our in-house capabilities and will accelerate recruitment of quality individuals to accomplish this end. If I can be of further assistance, please let me know.

An identical letter has been sent to the Subcommittee's Ranking Member, Congressman Tom Lewis.

Sincerely,

Joe

Joseph M. Del Balzo
Executive Director for
  System Development

Enclosure

Please provide for the record a table on positions filled since 1988 which demonstrates a commitment toward long term research and the build-up of in-house capability.

[The information follows:]

Federal Aviation Administration
Research, Engineering and Development
Positions Filled Since Fiscal Year 1988
Distribution by Location

Location	Date Hired	Position Title	GS/GM Grade	Educational Level	Concentration
Research & Development Service	12 / 89	Engineering Psychologist	14	BS/MA/PHD	Human Factors - Selection & Training
	8 / 90	Engineering Psychologist	14	BS/MA	Human Factors - Cockpit Technology
	9 / 90	Program Manager	15	BS/MS	Verticle Flight & Rotorcraft Program
	10 / 90	Engineer	13	BS/MS	Dynamic Oceanic Tracking System
	12 / 90	Research Psychologist	12	BS/MA/PHD	Human Factors - Pilot Error
	12 / 90	Program Manager	15	BS/MS	Satellites - Communication & Navigation
	2 / 91	Engineer	14	BS/MS	Automation Bridge
Operations Research Service	6 / 89	Operations Research Analyst	14	BS/MS/MA	NASPAC Development & Applications
	6 / 89	Operations Research Analyst	14	BS/MS	Economic Analyses for R,E&D Projects
	7 / 89	Operator Systems Specialist	14	BS	SIMMOD Software Development
	4 / 90	Operations Research Analyst	14	BA/MA/PHD	Traffic Management Model Development
	9 / 90	Operations Research Analyst	14	BS/MS	Nat'l Simulation Laboratory Prototyping
	10 / 90	Operations Research Analyst	14	BS/MS/MA	NAS Systems Analyses
	2 / 91	Computer Specialist	14	BS/MS	SIMMOD Development & Validation
	2 / 91	Program Manager	15	BS/MS	National Simulation Laboratory
	4 / 91	Computer Specialist	13	BS/MS/MBA	NASPAC Systems Analyses
Technical Center	10 / 87	Aero Space Engineer	14	MS	Aircraft Engineering & Modification
	1 / 88	Electrical Engineer	7	BS	MLS for Helicopter
	1 / 88	Electrical Engineer	9	BS	ATC Application of Data Link
	2 / 88	Computer Scientist	13	BS	Programing & Analysis NAS Simulation Fac
	6 / 88	Electrical Engineer	13	BS	Data Link
	7 / 88	Operations Research Analyst	14	MS	ATC Separation Standards
	8 / 88	Aero Space Engineer	13	BS	Aircraft Crash Worthiness
	8 / 88	Mechanical Engineer	13	BS	Aircraft Hardening
	8 / 88	Electrical Engineer	14	BS	Advanced Automation System
	9 / 88	Mathematician	7	BA	Global Position Satellite Implementation
	9 / 88	Aero Space Engineer	11	BS	Non-Destructive Testing
	10 / 88	Electrical Engineer	11	BS	Advanced Automation System
	10 / 88	Physics Scientist	12	MS	New Detection Technology
	10 / 88	Electrical Engineer	13	BS	Global Position Satellite Implementation
	11 / 88	Electrical Engineer	14	BS	Global Position Satellite Implementation
	11 / 88	Aero Space Engineer	14	MS	Install Elect Test Equip on FAA Aircraft
	1 / 89	Mathematician	7	BA	TATAC
	2 / 89	Supervisor General Engineer	15	PHD	Aging Aircraft
	5 / 89	Supervisor Engineer Research	15	PHD	ATC Human Factors
	6 / 89	Computer Scientist	14	BS	Advanced Automation System
	9 / 89	Mathematician	7	BS	Airport Capacity Modeling

Federal Aviation Administration
Research, Engineering and Development
Positions Filled Since Fiscal Year 1988
Distribution by Location

Location	Date Hired	Position Title	GS/GM Grade	Educational Level	Concentration
Technical Center (Cont)	9 / 89	Computer Scientist	7	BS	NAS Transition Planning
	11 / 89	Electrical Engineer	11	BS	Global Position Satellite Implementation
	1 / 90	Computer Scientist	13	BS	AAS System Support
	1 / 90	Computer Scientist	14	BS	Advanced Automation System
	4 / 90	Mechanical Engineer	14	MS	Aging Aircraft
	5 / 90	Research Meteorologist	14	PHD	Atmospheric Hazards
	5 / 90	Engineer Research Psychologist	12	PHD	ATC Human Factors
	7 / 90	Operations Research Analyst	13	BS	Security System Integration
	8 / 90	Electrical Engineer	14	BS	Explosive Detection
	8 / 90	Electrical Engineer	13	BS	Advanced Automation System
	9 / 90	Physics Scientist	14	PHD	Explosive Detection
	9 / 90	Electrical Engineer	5	BS	Advanced Automation System
	9 / 90	Operations Research Analyst	15	MS	Security System Integration
	9 / 90	Electrical Engineer	14	PHD	Explosive Detection
	9 / 90	Physics Scientist	14	PHD	Explosive Detection
	9 / 90	Research Chemist	14	PHD	Explosive Detection
	9 / 90	Research Chemist	14	MS	Explosive Detection
	10 / 90	Electrical Engineer	11	MS	Explosive Detection
	1 / 91	Aero Space Engineer	9	BS	Advanced Materials
	2 / 91	Engineer Research Psychologist	13	MS	Advanced Automation System
	2 / 91	Physics Scientist	12	PHD	Explosive Detection
	2 / 91	Electrical Engineer	7	BS	AAS System Support
	2 / 91	Electrical Engineer	13	BS	Install Elect Test Equip on FAA Aircraft
	2 / 91	Supervisor General Engineer	15	BS	Explosive Detection
	3 / 91	Aero Space Engineer	12	PHD	Aging Aircraft
	3 / 91	Supervisor General Engineer	15	MS	Explosive Detection
	4 / 91	Aero Space Engineer	5	MS	Aircraft Hardening
	4 / 91	Aero Space Engineer	12	BS	Aircraft Hardening
Civil Aeromedical Institute	1 / 88	Computer Programmer	9	AA	Research Support
	2 / 88	Psychology Technician	5	BA	ATC Selection/Screen
	3 / 88	Psychology Technician	5	BA	Color Vision/Stressors & Performance
	4 / 88	Computer Services Analyst	11		Tech Info Systems/Computer Systems
	5 / 88	Biological Aid	4	BS,AA	Forensic Toxicology
	7 / 88	Safety Engineer	13	BS	Cabin Safety
	8 / 88	Research Physiologist	12	PHD	Protective Breathing Equip
	10 / 88	Psychology Technician	5	BA	ATC Fatigue/Shiftwork & Performance
	1 / 89	Pathology Technician	4	ART	Forensic Toxicology
	1 / 89	Biological Lab Technician	7	AA	Protective Breathing Equipment
	2 / 89	Biomedical Engr Tech	5	BS	Vision Research
	4 / 89	Medical Technologist	9	BS	Forensic Toxicology
	7 / 89	Electronic Technician	9		Crashworthiness
	7 / 89	Personnel Research Psychologist	11	PHD	ATC Selection/Screen
	7 / 89	Biomedical Lab Tech	9	BS	Protective Breathing Equipment

Federal Aviation Administration
Research, Engineering and Development
Positions Filled Since Fiscal Year 1988
Distribution by Location

Location	Date Hired	Position Title	GS/GM Grade	Educational Level	Concentration
Civil Aeromedical Institute (Cont)	7 / 89	Psychology Physiologist	7	BS	Post-Accident Water Survival
	8 / 89	Research Chemist	14	PHD	Forensic Toxicology
	12 / 89	Research Chemist	12	MS	Forensic Toxicology
	1 / 90	Research Chemist	14	PHD	Combustion Toxicity
	1 / 90	Medical Technologist	9	BS	Forensic Toxicology
	3 / 90	Lab Support	4		Forensic Toxicology
	3 / 90	Psychology Technician	8	BS	ATC Validation of Academy Screen
	5 / 90	Research Medical Officer	14	MD	Accident Investigation
	5 / 90	Psychology Technician	8	MS	Fatigue & Performance (Color Vision)
	5 / 90	Medical Technologist	9	BS	Forensic Toxicology
	5 / 90	Research Mechanical Engineer	12	BS	Crashworthiness
	5 / 90	Chemist	11	MS	Forensic Toxicology
	7 / 90	Biomedical Engr Tech	7	BS	Aeromedical Cert. (Vision Research)
	7 / 90	Personnel Research Psychologist	12	PHD	Job Satisfaction Surveys
	8 / 90	Psychology Technician	8	BA	Operational Errors
	9 / 90	Psychology Technician	5	BS	ATC Alternative Aptitude Tests
	2 / 91	Vision Research Specialist	7	BS	Aeromedical Cert. (Vision Research)
	2 / 91	Medical Technologist	9	BS	Forensic Toxicology

Mr. **Lewis**. The law that was enacted in November, I want to ask you some questions about, by way of comparison on the progress of the FAA final research at that time.

On page 8 you stated that "We are continuing the pursuit of crashworthy aircraft with all fire-resistant cabin interiors." I want to examine in some detail what progress the agency has made in this area.

How many research scientists, trained in fire research, since 1988 are conducting full-time work for you? How many are really doing it? You probably don't have that off the top of your head.

Mr. **Del Balzo**. I don't have it off the top of my head, but rather than provide it for the record, which I can do, I would ask Gus Sarkos to address that question, and I'm sure that he does have it in his head, Congressman.

Gus?

Mr. **Sarkos**. Good morning.

Mr. **Lewis**. Good morning.

Mr. **Sarkos**. The question was, how many scientists do we have——

Mr. **Lewis**. Since 1988, have you hired engineering scientists and technicians and engineers and placed them into this program that are diligently working on fire-resistant cabin interior research?

Mr. **Sarkos**. We have not hired any.

Mr. **Lewis**. Shame on you guys. Shame on FAA. Do you have the people to do it?

Mr. **Sarkos**. We have people that are highly qualified to do fire safety research with regard to aviation. Yes, we do, Congressman, and we also have, as you know, very tremendous facilities to perform this research.

Mr. **Lewis**. I recognize that.

Mr. **Sarkos**. I think we've made great strides in terms of near-term research and work which has been applied in standards that have improved safety. I do think that we have to do a better job in the area that you are talking about, which is a more long-term fire safety research program.

Mr. **Lewis**. Are these people working full-time on this, every day?

Mr. **Sarkos**. Yes. We have——

Mr. **Lewis**. What type of people are they?

Mr. **Sarkos**. The type of people——

Mr. **Lewis**. I have met some of them, but do you have a scientist that is working on this? Do you have one or two or three engineers that are working on this full-time?

Mr. **Sarkos**. We have a total of 30 people in the Fire Safety Branch, full-time employees. About half of those people are technicians that operate the extensive facilities that we have, in-house facilities. We also have a number of engineers and chemists that are doing work——

Mr. **Lewis**. How many?

Mr. **Sarkos**. About 10.

Mr. **Lewis**. About 10? Engineers and chemists combined?

Mr. **Sarkos**. Engineers and chemists, yes, sir.

Mr. **Lewis**. Stay there a moment, because I'm sure we'll come ack to you.

Mr. Del Balzo, what is the comparison of the FAA budget in 1988 with the proposed 1992 budget as far as R&D?

Mr. DEL BALZO. The 1992 budget, baseline request——

Mr. LEWIS. I mean in fire research only.

Mr. DEL BALZO. In fire research, we're looking at a little bit over $6 million in the fire safety area. That's Gus' program, which is about, if I recall, almost double the last time we were here. I could be wrong, but I think that's about right.

Mr. LEWIS. Now, how is this being programmed out? This $6 million, is this being programmed out on today's problems today? Or are you looking at what you're going to do for the total fire interior restrictive material down the pike?

Mr. DEL BALZO. It's a combination. I don't have an exact percentage; maybe Gus has a better number. I think most of it is near-term. We will position ourselves in more long- term research in the cabin fire safety area through the Centers of Excellence that we talked about earlier.

I think what we see happening at the facility in Atlantic City is more hands-on for today and less basic research, less long-term research for tomorrow.

Our goal is to couple the hands-on capability that you see at the Technical Center with the long-term research and basic research at the Centers of Excellence, feeding the work from those Centers of Excellence into the hands-on work that Gus will be doing.

What that means is, we do need additional scientific people that can interface with the Centers of Excellence. We do need a world-class materials person that we don't have. So there are several additions to Gus' staff that we must make.

Mr. LEWIS. Why don't you have those people? It's been a couple of years. Why don't you have those people?

Mr. DEL BALZO. I think it's always a question of trading off and making do with resources that you have.

Mr. LEWIS. That's the point I wanted to make.

Mr. DEL BALZO. I understand. I understand.

But the fact is, we will never have enough to do everything. So when you say, would we have hired some people into cabin fire safety over the past year, the answer is yes, because over the past year I think there is no question—I don't know the exact number, but people did retire, so there were some vacant positions that we could have hired into. But those vacancies occurred at the same time that we were mounting a terrorism initiative, which is a new initiative for us. And when those initiatives have to be staffed before a budget request is submitted, you have no choice but to make do with what you have.

So we will pay the Cabin Fire Safety Program back in fiscal year 1992. There will be additional positions that we're requesting that I'm confident we will get in fiscal year 1992, and the program gets paid back.

But, Congressman, we do those trade-offs every day.

Mr. LEWIS. Well, that's the point, Mr. Del Balzo. The law doesn't give you a choice to trade off. It doesn't give you an opportunity to pick and choose. It says you will do the long-term R&D research. It says it right in the book, the law that we passed. It doesn't give you the opportunity to decide today that you're going to do this, and decide to do something else tomorrow. That's the point I'm trying to make. And what I'm trying to do is make the point to help you help FAA do the job for the people out there flying in these airplanes. And I have yet to hear you come before this committee, or the FAA Administrator, saying that you needed dollars in your budget to bring these positions to protect the lives of people flying in aircraft in the future. You have not done that, and I'd like to know why you have not done that. You tell me you're trading off to meet the emergencies that come up, but you don't have that flexibility in the law.

Mr. **Del Balzo**. Congressman, I don't want to sound offensive, so I'll just tell you what I know and what it is that we deal with every day. But there is a budget request this year, in fiscal year 1992, that does in fact request additional positions in research and development, and I'm confident that we will get those positions. I can tell you today where those positions will be applied, and some of those positions will be applied in cabin fire safety.

I cannot tell you whether or not, in the middle of 1992, in the middle of the budget year, if there is another crisis where we must mount an initiative, whether or not we won't take back a position from somewhere else to handle that crisis today. I don't know what the choices are.

Mr. **Lewis**. For the past two years, the committee has been concerned that your policy, the FAA's policy, has hampered the agency's ability to effectively conduct a long-term aviation research program. The GAO survey determined in 1989 that "During fiscal year 1988, reprogramming actions changed funding of 70 of the 99 subprograms designated by FAA in its Congressional submission. During the April 26, 1990 hearing, FAA witnesses admitted that the reprogramming actions continued in fiscal year 1989. The committee requests that FAA study its reprogramming policies and guidelines and report on their impact on long-term research, including that mandated by law, by January 1, 1991."

Did FAA do that?

Mr. **Del Balzo**. I can't answer that question, sir.

Mr. **Lewis**. I don't think they did.

Mr. **Del Balzo**. Okay.

Mr. **Lewis**. I don't think they did. This is the thing, I guess, that gets so irritating. You have a subcommittee that supports what you do, that is willing to go to the wall for what FAA wants to do, within reason. You don't give us a budget request, and sit down there and say that you need this to do your job, and place the emphasis on us and the responsibility on us to make sure we give you the funds in order to do your job, so now we're in the position of telling you this, and I think that's wrong. And I think it's certainly not in the best interest of the people of this country, and that's what your job is.

We're willing to take the heat. If we cut your budget, that's one thing, but when you don't ask for the blasted thing, then that's something else.

Now, you have good people working in FAA, and I've had the opportunity to be in Oklahoma, to be over in Atlantic City, talking to these people and understanding and finding out what they're doing, but those people can only do what they can do with what they have to do it with. And it's our responsibility and it's your responsibility and it's the Administrator's responsibility, even the Secretary of Transportation's responsibility, to make damn well sure that we give them the tools to do their jobs. Otherwise, what are we doing? We're saying that we reprogram, that emergencies come up, and I respect that. For a very, very short term, I can respect that, but not as an excuse why we didn't do the job, Mr. Del Balzo.

Would you say that we have an opportunity to come up with fire-resistant interiors on aircraft within a period of time that we could require the aviation industry to refurbish their aircraft with this material, and that we could have these aircraft built this way?

Mr. Del Balzo. I think we have an opportunity now. I think we have an opportunity based upon goals that we now believe in, goals that you talked about in previous hearings, but I think we had difficulty in working against them, a goal that says we want to design a system, or work toward a system, that in fact is fatality-free. I think we adopt that now, and we will do everything we can, and never give up, to pursue to a fatality-free system.

The thing that is different this year is that designing a fatality-free system starts at the beginning. You try to design a system that will never have an accident. What you will find in the R&D program are all of the things that we are doing to prevent an accident. An accident may occur, but if an accident occurs, you want to do everything that you can to ensure that the aircraft doesn't destruct. You will find in the R&D plan those things that will ensure that an aircraft is indestructible. If an accident occurs, you want to be sure that an aircraft doesn't go on fire, and there will be things that we do to prevent a fire. But if a fire does occur, you want to be sure that the passenger isn't hurt.

So all of the things that you talk about, I think we are now committed to aggressively pursuing. Can we do it all in-house, with in-house resources? The answer is no, we never could. But we will do the long-term research in support of that goal through the Centers of Excellence. We already have one in place. We have a Center of Excellence in place—it's a consortium made up of Iowa State and Northwestern University—that is devoted to the problem of aging aircraft. That's the first long-term research program that I believe is for real.

There is a second one that we have in place with Wichita State, and that's in crashworthiness. We now have the capability to put those vehicles in place, that we will not tamper with day-by-day. That's long-term research. That's the infrastructure that we have to put in place.

Mr. Lewis. Well, Mr. Del Balzo, that's why this committee gave you that flexibility, to go to Centers of Research.

Mr. Del Balzo. Yes, sir.

Mr. Lewis. I don't think we tied your hands in any way.

What I want you to do—and when I say "you," it's the FAA I'm speaking of—you don't have a choice. The law is very specific, so you can't pick and choose on what you want to do. I think when we took the time to do this—this committee put a lot of time in on this—we were looking at the interest of the people. The United States Congress is telling you, "This is what you're supposed to do," and I think we do represent the people. That's what I want you to do.

We have a lot more questions. I could go down a list of things—we have the Catastrophic Failure Prevention Research Program, which is another law that was passed, 101–508. This mandates the Administrator to "undertake or supervise research to develop technologies and methods to assess the risk of and prevent defects, failures, and malfunctions," like the bell, which the chairman has been very generous with for me, which could result in catastrophic failure of aircraft.

I don't see anything in this book that says anything about that at this point. When will you develop a plan for that?

Mr. **Del Balzo**. Congressman, I think part of the problem that we're having now is the fact that you're looking at the R&D plan that was issued last year. The R&D plan that I talk about, that was just developed, is this one.

Mr. **Lewis**. This is March, 1991.

Mr. **Del Balzo**. That's fiscal—fiscal—the R&D plan that I talk about, sir, is still in draft form, which you would not have. It's the one that I would provide you a briefing on and provide you the details on.

Mr. **Lewis**. On that point, I yield. [Laughter.]

On that point. The previous ones, no, because they should have been in here.

Mr. **Del Balzo**. Yes, sir. I agree with you, sir.

Mr. **Lewis**. Mr. Chairman, thank you for the time. There is just one more question I would like to ask Mr. Del Balzo.

I would like to know, Mr. Del Balzo, in Public Law 101–508 we contained a section on drug and alcohol testing, and the report states, "The committee directs the FAA to establish a research program to develop scientifically valid maximum allowable levels of alcohol, drugs, or other substances in the blood of pilots, air traffic controllers, and others who are in safety-critical positions. The focus of this research is to determine a scientifically-valid maximum safe level of alcohol, drugs, or other substances in the body, below [sic] which there is unreasonable risk of decreased human performance that would lead to error which would endanger safety."

Where do we stand on that program?

Mr. **Del Balzo**. Congressman, I cannot answer that question at this moment. With your permission, I would furnish it to you for the record within 24 hours.

Mr. **Lewis**. I'm going to hold you to that one.

Mr. **Del Balzo**. Yes, sir.

[The information follows:]

U.S. Department
of Transportation
**Federal Aviation
Administration**

800 Independence Ave., S.W.
Washington, D.C. 20591

May 17, 1991

The Honorable Tom Lewis
House of Representatives
Washington, DC 20515

Dear Mr. Lewis:

This is in response to your request at the May 16 hearing before the House Subcommittee on Competitiveness and Technology on the status of the Federal Aviation Administration (FAA) research to develop scientifically valid maximum allowable levels of alcohol, drugs, or other substances in the blood of pilots, controllers, and others in safety critical positions. As you correctly pointed out during the hearing, the direction to establish such a research program was contained in House Report 101-585, which accompanied H.R. 4949, the Federal Aviation Administration Research, Engineering, and Development Authorization Act of 1990.

The FAA has a long-standing and continuing interest in ensuring that the performance of operators, controllers, and other personnel within the National Airspace System is not impaired by drugs or alcohol. Regulatory initiatives have been used to restrict alcohol use and reduce the probability that safety personnel are active drug abusers. Research in this critical area is being conducted at the FAA's Civil Aeromedical Institute (CAMI) in Oklahoma City.

As you know, CAMI conducts research on the biomedical and psychological aspects of human performance, while research conducted at the Technical Center focuses on system technology and human engineering impacts. As you are well aware, CAMI has historically conducted active research to assist the National Transportation Safety Board in determining the role of medical factors in aviation-related accidents, including the presence of alcohol and drugs. That research continues today.

CAMI, which is a major component of the FAA's Office of Aviation Medicine, has a long-standing interest and involvement in research to determine the maximum allowable levels of alcohol/drugs and the extent to which drugs, alcohol, or other substances may impact performance. Alcohol and drug research being conducted at CAMI is specifically devoted to the determination of the presence of alcohol or drugs in blood and tissue samples from personnel involved in aircraft accidents.

In the last two years, we have significantly enhanced our research capabilities in this area, with the adding of state-of-the-art equipment, the hiring of new personnel, and the development of internal and external quality control procedures for the analysis of samples.

CAMI has also been involved with laboratory studies evaluating both short- and long-term (hangover) effects of alcohol on performance. Current research includes an investigation of the effects of low levels of blood alcohol performance in the use of localizer and glide scope operations through the use of simulators. Other on-going research includes improvement of means to detect chemicals such as alcohol, therapeutic, and illegal drugs; development of an automated, cognitive function test that is sensitive to chronic drug abuse (and its associated cognitive decrement); refinement of an automated cognitive function test which is sensitive to chronic drug abuse; and performance impact of calcium channel blocker antihypertensives.

CAMI will continue research in the development and evaluation of technology, procedures, and techniques for assessing the possible impairment of personnel. I am advised by the Associate Administrator for Aviation Standards that the status of our alcohol and drug research will be provided in a report to Congress by September 30, 1992.

If I can be of further assistance, please let me know.

An identical letter has been sent to Chairman Valentine.

Sincerely,

Joseph M. Del Balzo
Executive Director for
System Development

Mr. **Lewis**. I have a list of them up here, going all the way back to April of 1990, that I want the answers to, where I, the chairman, and the committee had asked for information that the committee has not received.

Okay. Mr. Chairman, I think I have made my point. I think Mr. Del Balzo has honestly answered my questions and responded to my frustrations, but I would like to point out that your question as to whether or not we should be meeting on a more frequent basis is certainly well taken, because if I'm in Congress another day or another 10 years, I'm going to follow these two laws that were passed, and I'm going to be a nemesis to FAA until they are doing what the law specifies that they should do, Mr. Del Balzo.

I appreciate you and the job that you're in. As I said earlier, I think you're the best thing that happened to FAA, and at least you come up here and give me honest answers. That's something that we're not very used to here on the subcommittee.

So I appreciate your testimony, and I hope you carry the message back that we're damned well tired of fiddling around any longer. I expect that we will get your budget, and we can look at this budget—before or after appropriations, I don't care—but this is the authorizing committee. We want to know how you're going to spend your money. We want to be able to discuss with you how you're spending it. We want to be able to discuss with you whether you can reduce something or do you need more, so that we can go to the mat for it. That's what we're here for. Once we do that, then we expect you to do your job. Right now, I'm not sure that's being done.

Thank you, Mr. Del Balzo.

Mr. **Del Balzo**. Yes, sir.

Mr. **Valentine**. Thank you, Mr. Lewis.

The Chair recognizes the gentleman from California, Mr. Rohrabacher.

Mr. **Rohrabacher**. Thank you very much, Mr. Chairman.

I note that this—it is interesting about this bar code. Down in North Carolina—Mr. Chairman, wasn't the bar code developed in your Congressional district?

Mr. **Valentine**. I thought you'd never ask. [Laughter.]

Yes. That was in Research Triangle Park. We claim that. That's our claim.

Mr. **Rohrabacher**. Thank you, Mr. Chairman.

I am very concerned that we have a contradiction in our system of certifying parts, that parts that go into our aircraft are actually meeting the standards that they're supposed to meet. I am concerned, as are my colleagues, of course, where you have counterfeiting and other such problems with airplane parts, but also the fact that our system itself, our own manufacturers, as the system is established, are responsible for certifying themselves that the parts that they manufacture do indeed meet the standards that are required. It seems to me that it's a contradiction and that it's an incentive for certain companies to actually misstate or to certify parts that do not meet the standards in order to meet deadlines.

I know that we have had problems with this, especially in the defense industry where we have seen that companies that are certifying parts for military aircraft are actually certifying the parts that they made, and they are false certifications.

Now, I note in the authorization bill for 1990—and this is just for your information; the deadline hasn't passed yet—but I would like to draw to your attention, on page 8 of that authorization act, it says, "In particular, the FAA shall examine the benefits of requiring parts to be certified by independent testing firms. The committee requests that the FAA report on the findings no later than October 1st, 1991."

Now, has anything been done as of yet to begin that investigation?

Mr. DEL BALZO. Congressman, the subject of bogus parts and certification parts is certainly one that has gotten a lot of attention from FAA. Yes, something has been done internally in FAA. I cannot provide you with details today.

Mr. ROHRABACHER. If you could let me know as soon as possible in writing, I would appreciate it, as to what the FAA is doing, in particular to chart what the cost and benefits are of independent testing, acquiring the independent testing of parts, rather than simply going with the current system which permits the manufacturers of airplane parts to certify themselves as to whether those parts have met the standards.

As I say, all of us here are concerned—as you are, and everybody in this room is—that when people get on airplanes, they know that they're going to get off those airplanes safely. There are different factors to this, and we have to make sure that the very viability of the airplane itself is looked at, and that the system that we have functioning now in the United States lends itself to making sure that all of these parts are going to do what's required of them.

So I would appreciate that answer in writing, and look forward on October 1st to your analysis as to whether or not independent testing would be of benefit to the public and what the costs and benefits are of independent testing.

Mr. DEL BALZO. Yes, sir.

Mr. ROHRABACHER. Thank you very much.

Mr. VALENTINE. Thank you, gentlemen, very much for your testimony.

We will proceed now to the next and the last panel, which consists of Mr. Steven J. Brown, Vice President for Strategic Planning and Policy, Aircraft Owners and Pilots Association, and Ms. Suzette Matthews, General Counsel, and Mr. Frank L. Frisbie, Director, Air Traffic Controller Association.

Mr. LEWIS. Mr. Chairman?

Mr. VALENTINE. Mr. Lewis?

Mr. LEWIS. If I may, I would like to ask, before Mr. Del Balzo leaves, I have approximately 10 more questions that I would like him to respond to. We will get those to you by tomorrow morning, and if you could respond by the 26th of May, that would be fine.

Mr. VALENTINE. Without objection.

Any problem with that, Mr. Del Balzo?

Mr. DEL BALZO. No, sir.

Mr. LEWIS. Thank you, sir.

[The questions and the answers thereto follow:]

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May 16, 1991

Mr. Joseph M. Del Balzo
Executive Director for
System Development
Federal Aviation Administration
800 Independence Avenue, SW
Washington, DC 20591

Dear Mr. Del Balzo:

Thank you for testifying at the Subcommittee's hearing on May 16, 1991. Your testimony will assist Members in their review of FAA's research and development.

Enclosed please find written questions submitted for the record as requested by the Subcommittee during the hearing. Please provide your response to these questions by May 26, 1991.

Again, thank you for your testimony and look forward to receiving your responses.

Sincerely,

Tim Valentine
TIM VALENTINE
Chairman
Subcommittee on Technology
and Competitiveness

Tom Lewis
TOM LEWIS
Ranking Republican Member
Subcommittee on Technology
and Competitiveness

Enclosure

QUESTIONS SUBMITTED FOR THE RECORD

FAA HEARING - MAY 16, 1991

I. Fire Safety Research

Public Law 100-591, section 2 mandates that the Administrator of the Federal Aviation Administration "undertake or supervise research" on the following:

A. "to assess the fire and smoke resistance of aircraft materials"

B. "and to develop advanced aircraft fuels with low flammability and technologies for containment of aircraft fuels for the purpose of minimizing post-crash fire hazards."

The report (100-894) to accompany this law specifically stated on page 12, "FAA should work toward a goal of a totally fire resistant cabin, or a cabin where survivors of a crash would have five or ten minutes to evacuate the cabin."

1. Has FAA hired any research scientists trained in fire research since 1988 who are conducting full time work on A? B?

2. What is the comparison of the FAA budget in 1988 with the proposed 1992 budget in a? b?

3. Finally, one measure of scientific progress is the number of scientific articles on this topic that have been published in peer review journal. Have any been published since 1988 in A? B? (If yes supply references to the Subcommittee.)

II. FAA Reprogramming

The Report, 101-585, to accompany the FAA R&D provisions in P.L. 101-508, signed November 6, 1990 states on page 14:

"For the past two years, the Committee has been concerned that FAA policy has hampered the Agency's ability to effectively conduct a long-term aviation research program. A 1989 GAO survey determined that '...during fiscal year 1988, reprogramming actions changed funding in 70 of the 99 subprograms designated by FAA in its congressional submission.' During the April 26, 1990 hearing, FAA witnesses admitted that the reprogramming actions continued in FY-1989. Accordingly, **the Committee requests that FAA study its reprogramming policies and guidelines and report on their impact on long term research, including that mandated by Public Law 100-591, by January 1, 1991.**"

The report has not been received by the Committee.

1. What is the status of the report?

2. Please supply a date on which the Committee will receive the report?

III. FAA Research Advisory Committee

Public Law 100-591 established a Research Advisory Committee. The 20 members (101-508 increased the number to 30) are to be made up of representatives of universities, corporations, associations, consumers, and other government agencies.

1. Please identify the number of members who are in each category:

   A. Universities?
   B. Corporations?
   C. Associations?
   D. Consumers?
   E. Other government agencies?

2. Of the members on the Advisory Committee, how many have ever had "education, training or experience" in scientific research in aviation safety? If yes, please list the names.

3. Do any of the members on the Advisory Committee have any experience in conducting scientific research in fire safety? Please list the names.

IV. Catastrophic Failure Prevention Research Program

Section 9208 of Public Law 101-508, signed November 6, 1990, is a provision on "Catastrophic Failure Prevention Research Program."

This section mandates that the Administrator mandated to undertake or supervise research "...to develop technologies and methods to assess the risk of and prevent defects, failures, and malfunctions ... which could result in a catastrophic failure of an aircraft."

(Report 101-585, p. 8, requests a FAA report by October 1, 1991.)

1. What long-term research program(s) does FAA have to fulfill the provisions of this law?

2. When will FAA develop a plan and submit to Congress for this mandated research?

V. Drug and Alcohol Program

Report 101-585 to accompany Public Law 101-508 contains a section drug and alcohol testing. Specifically, the report states:

"The Committee directs the FAA to establish a research program to develop scientifically valid maximum allowable levels of alcohol, drugs, or other substances in the blood of pilots, air traffic controllers, and others who are in safety critical positions. The focus of this research is to determine a scientifically valid maximum safe level of alcohol, drugs, or other substances in the body, below which there is unreasonable risk of decreased human performance that would lead to error which could endanger safety."

Ten million dollars was authorized for fiscal years 1991 and 1992.

A report to Congress was requested by September 30, 1992.

1. What is the status of implementing this provision?
2. What is the plan of action between now and September 30, 1992?

U.S. Department
of Transportation

**Federal Aviation
Administration**

800 Independence Ave., S.W.
Washington, D.C. 20591

May 28, 1991

The Honorable Tim Valentine
Chairman, Subcommittee on
  Technology and Competitiveness
Committee on Science, Space,
  and Technology
House of Representatives
Washington, DC 20510

Dear Mr. Chairman:

This is in response to your recent letter transmitting questions for the record from the Subcommittee's May 16 hearing on the Federal Aviation Administration's (FAA) Research, Engineering, and Development Program.

Enclosed are the answers in the order in which the questions were presented.

An identical letter has been sent to Representative Tom Lewis.

Sincerely,

Joseph M. Del Balzo
Executive Director for
  System Development

Enclosure

I. FIRE SAFETY RESEARCH

Public Law 100-591, Section 2, mandates that the Administrator of the Federal Aviation Administration "undertake or supervise research" to:

A. "assess the fire and smoke resistance of aircraft materials"; and

B. "develop advanced aircraft fuels with low flammability and technologies for containment of aircraft fuels for the purpose of minimizing post-crash fire hazards."

The report (100-894) to accompany this law specifically stated on page 12 that "FAA should work toward a goal of a totally fire resistant cabin, or a cabin where survivors of a crash would have five or ten minutes to evacuate the cabin."

1. Has FAA hired any research scientists trained in fire research since 1988 who are conducting full-time work on A? B?

As we indicated during our testimony, FAA has not hired any research scientists trained in fire research or fuels or fuel containment since 1988. Available positions were devoted to the hiring of scientists and engineers to support aging aircraft and security related research initiatives. We do, however, have a complement of 30 technicians, chemists, and engineers, several with world-class reputations in their field, diligently working to develop a fire-resistant cabin interior.

2. What is the comparison of the FAA budget in 1988 with the proposed 1992 budget in A? B?

	1988	1992
A.	$125K	$ 650K
B.	$660K	$1225K

3. Finally, one measure of scientific progress is the number of scientific articles on this topic that have been published in peer review journals. Have any been published since 1988 in A? B? (If yes, supply references to the Subcommittee).

Since 1988, no scientific articles have been published in peer review journals relative to these specific areas. However, the following papers, presentations, or reports were prepared or presented over this time period and, similarly, reflect scientific progress concerning these topics of interest:

(A)

1. Cahill, P.L., and Dailey, J.H., "Aircraft Electrical Wet-Wire Arc Tracking," Federal Aviation Administration, Report DOT/FAA/CT-88/4, August 1988.

2. Sarkos, C.P., "Full-Scale Fire Testing," Aircraft Interior Materials/Fire Performance Conference, Wichita State University, April 4-15, 1989.

3. Sarkos, C.P., "Development of Improved Fire Safety Standards Adopted by the Federal Aviation Administration," AGARD Conference on Aircraft Fire Safety, Sintra, Portugal, May 22-26, 1989.

4. Sarkos, C.P., and Hill, R.G., "Characteristics of Transport Aircraft Fires Measured by Full-Scale Tests," Advisory Group Aerospace Research and Development (AGARD) Conference on Aircraft Fire Safety, Sintra, Portugal, May 22-26, 1989.

5. Cahill, P.L., "Flammability, Smoke, and Dry Arc Tracking Tests of Aircraft Electrical Wire Insulations," Federal Aviation Administration, Report DOT/FAA/CT-89/21, July 1989.

6. Sarkos, C.P., "FAA Test Requirements for Aircraft Interiors," the 1990 Conference on Flame Retardancy of Polymeric Materials," Stamford, Connecticut, May 15-17, 1990.

7. "Aircraft Material Fire Test Handbook," Federal Aviation Administration, Report DOT/FAA/CT-89/15, September 1990.

8. Sarkos, C.P., "Full-Scale Fuselage Burnthrough Tests," European Cabin Safety Conference 1990, London, England, September 18-21, 1990.

9. Eklund, T.I., Invited Paper, "Fire Containment and Heat Release Issue in Composites," National Academy of Sciences, Marine Board, Conference on Use of Composites in Marine Structural Applications, Washington, D.C., September 24, 1990.

(B)

1. Beltran, M., and Kosvic, T., "Reduction of Post-Crash Fire Potential," Beltran Associates, Inc., CRC-Aviation Fuel, Lubricant, and Equipment Research Committee, April 14, 1988.

2. Beltran, M.R., and Kosvic, T.C., "Post-Crash Aircraft Fuel-Fed Fire Prevention," Final Report, Contract DTRS-57-C-00087, April 1988.

3. Salmon, R.F., "Fuel Containment System Concept to Reduce Spillage," Federal Aviation Administration, Report No. DOT/FAA/CT-TN89/22, June 1989.

4. "Investigation of Fuselage Fuel Tank Installations Subjected to Crash Pulses," Federal Aviation Administration, Report No. DOT/FAA/CT-88/24, July 1989.

5. Lister, E., "Post-Crash Fire Risk Assessment," Galaxy Scientific Corporation, CRC-Aviation Fuel System Safety Group, April 25, 1991.

6. Lister, E., "Post-Crash Fire Risk Assessment," Draft Final Report, Contract DTFA03-89-C-00043, May 1991.

7. "Longitudinal Pulse Test Results for a Transport Airplane Section with an Auxiliary Floor-Mounted Fuel Tank," Report No. DOT/FAA/CT-91/3, June 1991.

II. FAA REPROGRAMMING

The Report 101-585, to accompany the FAA R&D provisions in P.L. 101-508, signed November 6, 1990, states on page 14:

"For the past two years, the Committee has been concerned that FAA policy has hampered the agency's ability to effectively conduct a long-term aviation research program. A 1989 GAO survey determined that "...during fiscal year 1988, reprogramming actions changed funding in 70 of the 99 subprograms designated by FAA in its Congressional submission." During the April 26, 1990, hearing, FAA witnesses admitted that the reprogramming actions continued in FY 1989. Accordingly, the Committee requests that FAA study its reprogramming policies and guidelines and report on their impact on long-term research, including that mandated by Public Law 100-591, by January 1, 1991."

The report has not been received by the Committee.

1. What is the status of the report?

FAA's prior year reprogramming practices are changing dramatically. The Senate and Conference reports accompanying the Fiscal Year 1991 Department of Transportation and Related Agencies Appropriations Bill, P.L. 101-516, dated November 5, 1990, directed the FAA to initiate new procedures to be followed for FAA programs and activities. These new procedures require prior Appropriations Committee (House and Senate) approval on reprogramming actions involving projects terminated prior to completion and funding shifts, either increases or decreases of more than 25 percent or $3,000,000 (whichever is less).

As of April 30, 1991, reprogramming actions for FY 1991 totaled only $4.5 million, or 2.2 percent of the $205 million R&D appropriation. This represents a 79 percent reduction in dollar terms from FY 1990. While these reprogramming actions still changed funding in 40 of the 91 subprograms designated in our budget submission, only four were in excess of $250,000, with $1 million being the largest amount reprogrammed. Only one reprogramming action was forwarded for congressional approval ($5 million for the airport surface traffic automation/airport movement area safety system) and is pending congressional response. No funds were reprogrammed out of the aircraft structures, fire safety, human factors, aeromedical research, or computer simulation model areas.

With respect to long-term research, the FAA is currently in the process of applying the definition of long-term research, as defined in P.L. 101-591, to the subprograms to precisely qualify and quantify it. The GAO survey in 1989 verified that FAA's overall program does indeed adhere to the Congressionally mandated 15 percent long-term research criteria, reporting a figure of 35 percent for the subprograms carrying into FY 1990. We believe that our 1991 R,E&D Plan at least sustains this funding level. We have already contacted GAO and will be working with them to achieve a common understanding of long-term research.

2. Please supply a date on which the Committee will receive the report.

The FAA has a commitment to report all reprogramming actions, including those which do not require prior Congressional approval, to the Appropriations Committees. It is our intent to provide a copy of this reprogramming report to the Subcommittee on Technology and Competitiveness, along with our assessment of the impact on long-term research at that time. We expect this report to be available shortly after the close of FY 1991.

III. FAA RESEARCH ADVISORY COMMITTEE

Public Law 100-591 established a Research Advisory Committee. The 20 members (P.L. 101-508 increased the number to 30) are to be made up of representatives of universities, corporations, associations, consumers, and other Government agencies.

1. Please identify the number of members who are in each category:

    a. Universities?
    b. Corporations?
    c. Associations?
    d. Consumers?
    e. Other government agencies?

The current breakdown of members is as follows: two representatives from academia; seven from corporations; five from associations; two from other government agencies; and three consultants.

We are currently in the process of adding a consumer member. Also, as I indicated in my testimony, several of the advisory committee members have completed their two-year terms. As a result of the increase in membership authorized by section 9209(b) of the Federal Aviation Administration Research, Engineering, and Development Authorization Act of 1990, we are taking steps to ensure that the expanded committee will have more members from academia and more with direct involvement in scientific research. These new members will also provide advice on our research grant program and future activities related to Centers of Excellence.

2. Of the members on the Advisory Committee, how many have ever had "education, training, or experience" in scientific research in aviation safety? If yes, please list the names.

Although almost one-third of the Committee's present membership possesses experience of a scientific research nature in some area of aviation safety, we strictly interpreted your question to mean those individuals with a scientific research background in the purest sense of the term. Only two members currently on the committee have these qualifications: John McCarthy, Ph.D., manager of the Research Applications Program at the National Center for Atmospheric Research and Garrison Rapmund, M.D., a former Assistant Surgeon General of the Army for Research & Development.

3. Do any of the members on the Advisory Committee have any experience in conducting scientific research in fire safety? Please list the names.

   Dr. Garrison Rapmund has had experience in conducting medical research with respect to fire-retardant clothing for the military.

IV. CATASTROPHIC FAILURE PREVENTION RESEARCH PROGRAM

Section 9208 of Public Law 101-508, signed November 6, 1990, is a provision of the "Catastrophic Failure Prevention Research Program." This section mandates the Administrator to undertake or supervise research "...to develop technologies and methods to assess the risk of and prevent defects, failures, and malfunctions...which could result in a catastrophic failure of an aircraft." Report 101-585, page 8, requests an FAA report by October 1, 1991.

1. What long-term research program(s) does FAA have to fulfill the provisions of this law?

Aviation safety has been and will continue to be the FAA's primary mission. The agency recognizes the significance of conducting research to assess the risk of and prevent defects, failure, and malfunctions, which could result in a catastrophic failure of an aircraft. There are ongoing independent FAA and joint studies with industry to both assess the status of the current fleet and to develop a technology base from which a long-term research program will be formulated.

Current ongoing joint FAA and industry efforts are being conducted under the FAA Research and Development Advisory Committee's Transport Airplane Safety Subcommittee. The subcommittee's charter is to consider the adequacy of research programs (underway and planned) in the areas of aircraft survivability and airworthiness. System review task force groups have been set up to consider airworthiness assurance, specific airframe design philosophy (flight critical systems), turbine engine hazards (containment) and other hazards as defined.

Current independent FAA studies include projects being conducted at the Center for Aviation Systems Reliability at Iowa State University in the areas of technology applications, engineering research and education and training. In the area of turbine engine hazards, the FAA's Titanium Rotating Components Review Team recently completed an exhaustive study and report that had been initiated by the DC-10 accident at Sioux City. The report included specific research and development recommendations. The FAA has also been conducting research in the advanced lightweight materials for turbine rotor failure hazards protection, failure prediction diagnostics and advanced in situ rotor system inspection techniques.

In the area of damaged flight control systems airworthiness, studies by the military provide a promising technology transfer opportunity. Ongoing structures research has included effects of large-scale delamination on composite structure and the effects of bonded composite material patches on damage-tolerant aircraft structure. It is anticipated that the results and recommendations of the aforementioned ongoing activities, which are scheduled for completion during fiscal year 1991 and 1992, will form the foundations for a long-term research program. Plans include establishing Centers of Excellence as focal points for specific research and information dissemination to industry. Research will be focused on turbine engine/APU hazards prevention, fuselage structural failure prevention, damaged flight control system airworthiness and other areas as identified.

The FAA reserves the right to adjust the requested funding levels each year based on the results of research conducted and industry design developments.

2. When will FAA develop a plan for conducting this mandated research and submit it to Congress?

Based on the committee assessment studies and ongoing research, we anticipate preparation of a research program plan during the next fiscal year.

V. DRUG AND ALCOHOL PROGRAM

Report 101-585 to accompany Public Law 101-508 contains a section on drug and alcohol testing. Specifically, the report states:

> "The Committee directs the FAA to establish a research program to develop scientifically valid maximum allowable levels of alcohol, drugs, or other substances in the blood of pilots, air traffic controllers, and others who are in safety critical positions. The focus of this research is to determine a scientifically valid maximum safe level of alcohol, drugs, or other substances in the body, below which there is unreasonable risk of decreased human performance that would lead to error which could endanger safety."

Ten million dollars was authorized for fiscal years 1991 and 1992.

A report to Congress was requested by September 30, 1992.

1. What is the status of this provision?

At the Subcommittee's May 16 hearing, Representative Lewis asked that we respond to this question within 24 hours. A written response was provided to you on May 17.

2. What is the plan of action between now and September 30, 1992?

See previous answer.

Mr. VALENTINE. The written testimony of the witnesses as presented to the subcommittee, of course, will appear in the record in toto, and we would urgently request you to summarize and keep the summaries to no more than five minutes.

Mr. Brown.

STATEMENT OF STEVEN J. BROWN, VICE PRESIDENT FOR STRATEGIC PLANNING AND POLICY, AIRCRAFT OWNERS AND PILOTS ASSOCIATION, FREDERICK, MD

Mr. BROWN. Thank you, Mr. Chairman, Mr. Lewis, Mr. Rohrabacher.

AOPA appreciates the opportunity to appear before the subcommittee today to testify on FAA's RE&D programs, especially as they relate to long-term research and their programs in preparing the FAA and the industry for the 21st century.

I am Vice President for Strategic Planning and Policy for AOPA, and a part of my responsibilities is to interact with FAA on their R&D programs.

As you know, we represent 300,000 individual members, general aviation pilots, which comprise about 60 percent of all the pilots in the United States, and our members use their aircraft for personal and business transportation purposes.

Overall, we believe FAA's RE&D program is biased toward short-term, air traffic control-related, and system-efficiency programs. Like many of the members have expressed this morning, Mr. Chairman, we believe that an increased emphasis should be placed on medium and long-term programs that would emphasize increases in system capacity, satellite navigation, aviation weather programs, and particularly, aviation fuel needs.

We really believe that the FAA's RE&D program in the past has often become a flexible spending account for the agency's F&E programs. We don't believe that's appropriate. Clearly, long-term research is needed, and the FAA should take a leadership role in order to preserve United States competitiveness in the aviation industry.

The Administration, as you know, has proposed for 1992 a funding level for the RE&D program of $210 million. Also as you are intimately aware, the authorization level is $260 million, and as AOPA has testified in the past, we believe that the future authorization level should build the FAA program to at least $300 million in the next round. We believe this level is important to ensure that FAA maintains its leadership positions on the issues that we're most concerned with, and also with the leadership that is necessary in the international community on air traffic-related programs that FAA is involved with.

Specific to the satellite system that we are proponents of and that FAA has begun a research program on, and that also Mr. Colson testified on this morning, we believe that the transition to a satellite system should occur more rapidly than FAA has generally believed is possible. We were encouraged this morning to hear Mr. DelBalzo say that their target is the mid-1990s; in fact, I think he specifically said 1995. This is a far quicker pace than FAA has discussed in the past, and it is certainly one that we're encouraged by.

As the committee probably is aware, the Defense Department is currently planning to commission that system for civil use in 1993. But we believe that large increases in FAA research and development funds will be necessary to provide the programs and the initiatives necessary for civil users to take advantage of GPS by 1995.

The benefits of deploying the satellite system early are twofold, Mr. Chairman. The short-term benefits are primarily to avoid some of the NAS programs that have been radically delayed and are far over budget and cost, that are in process now. Many of those programs, which we estimate to be at a level of about $11 billion, could be foregone if we could make a rapid transition to the satellite system.

The long-term benefits of this satellite system to the users, as well as to FAA, is increased capacity and system efficiency that will generate straight-line paths, area navigation, and minimum times en route, compared to the current system, which is a ground-based system and doesn't allow that kind of flexibility.

So we hope that FAA will be able to accelerate these programs, but it will require support from your committee with increased funding levels, that I discussed before, to make that possible. There is a great deal of basic research as well as applied research, testing, and demonstration of ground-based air traffic control equipment that would be required to make that satellite system available to civil users by 1995.

Mr. Chairman, as you are well aware, and as I am sure Mr. Lewis is aware, the FAA owes a report to this committee by October of this year on their coherent plan for the transition to the satellite system. We hope that you will monitor that vigilantly and that you will hold FAA to coming forward with that plan, which will chart a clear implementation for this system to replace our current Air Traffic System.

Of great concern to us this year is the issue of general aviation fuels. With the passage of last year's Clean Air Act and in particular section 226, we've become more intimately involved with EPA than we ever have in the past. We hosted a fuel conference in March of this year to discuss the implications of the Clean Air Act for our industry and our membership. There were two very interesting aspects that developed as a part of that conference.

The first is that section 226, as currently under consideration by the EPA, may apply to general aviation aircraft and may apply to our industry. This section basically prohibits the use of lead-burning engines after 1992. In our subsequent dialogue with EPA we have come to learn that their interpretation and study of the act's provisions will probably indicate that our industry will not be subject to the prohibition on lead in engines in general aviation aircraft, that it was in fact intended for other engines.

But if in fact that interpretation—which we expect soon, and which we expect to be favorable—doesn't come forward in a timely way, we may need legislation to clarify this particular aspect of the legislation.

Let me point out why this is a problem for us in our industry. The fact of the matter is, as you are well aware, that there are low-lead fuels available in other industries. But general aviation gasoline, or AVGAS, as it is commonly referred to, contains lead in higher levels than what are in existence in other industries. The reason for that is that aviation engines, of course, are lightweight; they have high compression ratios, far beyond what you would find in automobiles and other vehicles; and they have higher performance standards, as well as certification standards, that far exceed those for ground vehicles. As a result, there is no known technology that will replace lead as a high octane component in these fuels.

So the critical issue before us from a long-term research perspective is, what kinds of additives can be added to AVGAS to replace lead and provide the high octane that is necessary for those fuels. There are no known additives at this point that have been completely researched, and even when those additives are found, it has to be determined that they are environmentally compatible under EPA guidelines, and it also has to be determined that those fuels would be compatible with existing parts and materials that are in existing airplanes. If they aren't, then clearly we can't use them in our aircraft.

So there is a technology barrier here. There is a need for long-term research. Fortunately, the FAA Technical Center, prior to 1988, had some very promising research under way. We believe that program needs to be regenerated, and we have indicated that at least a million dollars is needed in the coming year to conduct that research, get it under way, and try to bring it to a conclusion.

Lastly, Mr. Chairman, there are two points associated with long-term research that are of particular concern to us in general aviation.

The first is aviation weather programs, and this is a funding area where FAA has diminished its resources and allowed the program to erode over the recent past. As you know, general aviation flies in the weather. Our aircraft fly at lower altitudes, typically, than airline aircraft, and as a result we essentially live in the weather. Airline aircraft are fortunate enough often to fly over the weather. As a result, more than 25 percent of general aviation accidents on an annual basis involve weather. More than 40 percent of the fatal accidents in general aviation involve weather, and 60 percent of all the system delays involve weather.

So there is clearly a very high system capacity, efficiency, and safety payoff to providing enhanced hazardous weather information to pilots, particularly for general aviation pilots.

Our priorities for improved aviation weather are primarily in the area of forecasts, and there is research that is needed to determine how these forecasts can be put together, based on what we know today. The areas in which hazardous weather is most important to us is in the area of in-flight icing, thunderstorms, and also in heavy snow forecasting.

Lastly, Mr. Chairman, in the area of human factors, FAA has recently put together another national plan. This is their first national plan for aviation human factors. It is an excellent outline of programs for research and development that FAA could undertake if they had the funding to pursue human factors research.

These clearly are long-term research programs, if they are to be funded. In fact, they would address what today is the preeminent factor in all accidents across the aviation spectrum, which is the human performance component and human errors.

FAA's R&D programs over the years have had a distinct bias toward the science of black boxes, as we refer to it, the inventing of new electronic gadgets to try to solve problems, and much of that is well-focused and appropriate. But as I think you can appreciate from Mr. Del Balzo's testimony, they have to go outside to look for technology expertise in areas beyond the black boxes and into the soft sciences. This is clearly an area where we would encourage the committee to have FAA look outside their own expertise because it is very limited inside the agency. This kind of human factors research has probably the highest safety payoff that we consider that FAA could undertake in long-term research, and we would encourage you to provide solid support for their new national plan.

That concludes my abbreviated statement, and I will look forward to your questions.

[The prepared statement of Mr. Brown follows:]

AOPA
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Statement of Steven J. Brown

Vice President
Strategic Planning & Policy

Aircraft Owners and Pilots Association

Before the

House Committee on Science, Space and Technology
Subcommittee on Technology and Competitiveness

The Honorable Tim Valentine, Chairman

Concerning FAA's
Research, Engineering & Development Programs
"Moving America Into the 21st Century"

May 16, 1991

Member of International Council of Aircraft Owner and Pilot Associations

Mr. Chairman, my name is Steven J. Brown. I am Vice President for Strategic Planning and Policy for the Aircraft Owners and Pilots Association.

AOPA represents the interests of 300,000 individual members who own and fly general aviation aircraft to fulfill their personal and business transportation needs. That is 60% of the active pilots in the United States. AOPA members own or lease 62% of the aircraft in the general aviation fleet.

RESEARCH FUNDING, GENERALLY

We appreciate this opportunity to appear before the Subcommittee to discuss FAA's Research, Engineering and Development programs. In our view, FAA's RE&D program is overly biased toward engineering and development of short term air traffic control related items. Much more emphasis and funding should be placed on research that has medium and long-term benefits in the areas of satellite navigation, aviation weather, and general aviation fuel. FAA's RE&D efforts should not be a flexible spending account for the agency's favorite Facilities and Equipment programs.

FAA's RE&D program is also heavily biased toward system efficiency and does not sufficiently address the nation's pressing need for large-scale system capacity improvements. Other areas of the FAA budget are designed to address management of today's problems and, clearly, the RE&D focus should be on capacity and safety for the 21st century.

Technology has advanced to a point where initial implementation of a hybrid air traffic system linking satellites with a ground-based system, such as LORAN C, for communications, navigation, and surveillance is feasible beginning in the mid-1990's. A hybrid space/earth system linking the Global Positioning System with ground-based, random-routing capability would provide much greater accuracy, reliability, and integrity than the current system. It would also be significantly less costly to operate.

Our ability to accelerate the inevitable transition to a space/earth system hinges largely upon adequate levels of FAA RE&D funding. AOPA has proposed substantially higher funding levels of $300 million for RE&D in each of the next five years. This will ensure that the research can be completed to help us achieve an accelerated transition to the next generation of technology. Compare this to FAA's much lower funding requests.

For FY92, the Administration has proposed an RE&D budget of $210 million -- an increase over previous years, but still well below the authorized level of $260 million. Much higher funding levels for satellite related technology will be necessary if we are to keep pace and take advantage of emerging capabilities. This year, AOPA is recommending to the House and Senate Appropriations Committees that they consider a substantial increase over the Administration request. This would be an important and essential step, building towards the $300 million RE&D funding levels we foresee as necessary in the coming years.

TRANSITIONING TO THE FUTURE -- SATELLITE TECHNOLOGY

AOPA contends that FAA's present course, which focuses on completion of the projects comprising the original National Airspace System Plan regardless of how long it takes, does not represent the most prudent technological nor fiscal solution to modernizing our air traffic control and airways systems. FAA's course should be redirected.

Last year, AOPA concluded an in-depth review of the nation's air transportation system. Our findings and recommendations are contained in a report to Congress entitled Aviation: The Future is Now.

Our central recommendation is that FAA should initiate an aggressive effort now to begin the transition to the next generation air traffic system linking satellites with a ground-based system such as LORAN C. Our analysis indicates that FAA would realize an estimated cost saving of $11 billion.

FAA recently published its "Concepts and Descriptions of Future Air Traffic Management System for the United States." This system description includes the following:

> "The primary sole-means of navigation for terminal, en route and oceanic IFR flight operations will be the Global Navigation Satellite System. This system will include an adequate number of satellites and monitoring provisions to ensure the required level of reliability, integrity and availability."
>
> "A category I approach and landing capability will be provided by Global Navigation Satellite System in combination with ground-based equipment providing differential corrections to the ranging signals available from the satellites. Category II and III approach and landing capability will be provided by the Microwave Landing System, MLS."

While we at AOPA appreciate the significance of this policy statement, a large increase in R&D funding will be necessary to complete the research, testing, and demonstrations required to fulfill this commitment.

The U.S. government's Global Positioning System already has launched 15 of 24 satellites, which will provide three-dimensional position reporting. All the GPS satellites are scheduled to be in orbit by the end of 1992. The USSR has also embarked on development of its own satellite air navigation system called GLONASS, which could be integrated with the U.S. system to provide worldwide coverage.

In these times of increasingly scarce resources, the substantial short and long-term cost savings inherent in transitioning to such a system are too good to pass up. If we begin the transition process now, we can save billions on some of the existing NAS Plan programs which will be unnecessary or incompatible with the system of the future.

In addition to navigation, greatly enhanced communications and surveillance capabilities will be possible through the use of satellites. Communications between aircraft and the ground will be accomplished through satellite relayed voice communications and also through the use of data link. The NAS plan Mode S data link is not the only way, nor is it necessarily the best way of providing data link services. Both existing VHF services and proposed satellite avionics are other viable alternatives which FAA has not fully investigated. These or similar satellite services could obviate the need for expensive ground based Mode S data link technology.

Last year, this Committee accepted AOPA's recommendation that it instruct FAA to develop a plan for transitioning to the next generation of satellite technology and to report its plan to Congress by October 1, 1991. Nearly $4 million was appropriated to FAA specifically for completion of this task. Your continued oversight and influence will help keep development of the plan on track and ensure that FAA begins to take aggressive steps towards implementation of the system of the future.

We are also pleased that our colleagues from the Air Transport Association recently testified before the House Appropriations Committee that they, too, believe satellite navigation programs should be given high priority among FAA's long-range RE&D needs. Our two organizations concur that an appropriation of $10 million for FY92 is appropriate to ensure that substantial research goes forward in this area. This Committee can play an essential role by emphasizing the need to continue planning for the future.

GENERAL AVIATION FUEL CRISIS

Fuel prices have increased dramatically for our members as a result of the situation in the Middle East. Aviation gasoline is selling for an average price of $2.12 per gallon nationwide, an increase of 15% since last August. But that is just the tip of the iceberg.

Several long-term fuel availability problems have emerged which are so serious that major segments of the general aviation fleet may ultimately be grounded. AOPA sponsored a General Aviation Fuel Crisis Conference on March 13 to discuss these problems. Considerable attention was focused on one key aspect of the broad problem of fuel availability -- that is, our current effort to ensure that EPA correctly interprets Section 226 of the Clean Air Act Amendments of 1990.

Section 226 prohibits the manufacture, sale, or introduction into commerce of any highway or nonroad engine which requires leaded gasoline after model year 1992. AOPA and our colleagues in the industry maintain that the ban on leaded gasoline burning engines does not apply to general aviation aircraft. Because of limitations in technology, a contrary interpretation of the Act will essentially bar the manufacture of any new piston-powered aircraft. Here is why.

High-powered, low weight aircraft engines require very high octane fuels to operate safely and efficiently. Fuel producers tell us that it is currently impossible to manufacture the high octane aviation gasoline required by aircraft engines without the addition of tetra ethyl lead. And most experts agree that high performance aircraft engines which will burn lower octane unleaded fuel cannot be designed and produced in the foreseeable future.

Even if the technological barriers could be surmounted, fuel availability problems will render new unleaded fuel burning aircraft engines useless. The nearly 200,000 piston-powered aircraft in the existing general aviation fleet all burn leaded gasoline. In contrast, fewer than 1,000 new piston-powered aircraft are manufactured annually. For obvious market reasons, fuel refiners and distributors simply will not produce the tiny amounts of specially formulated unleaded aviation gasoline which would be required by new piston-powered aircraft.

AOPA has worked closely on this issue with the leadership of the House Energy and Commerce Committee and the Senate Committee on Environment and Public Works. We are optimistic that EPA will soon release its own formal interpretation of the engine ban, and that it will exclude aircraft from the ban.

Nevertheless, long-term fuel availability problems will remain unless an alternative, unleaded fuel is developed with a sufficiently high octane level to meet the requirements of both new and existing high performance aircraft engines. We request assistance from the Committee on this aspect of the problem.

Prior to 1988, FAA's Technical Center in New Jersey conducted promising research into alternative fuels for general aviation aircraft. Our analysis suggests that an appropriation of $1 million for FY92 is necessary to complete the promising research previously initiated by FAA. We are requesting these funds from the Appropriations Committees, and special emphasis from this Committee on the need for development of an alternative fuel will be invaluable. Research into alternative fuels is vital to the continued viability of general aviation.

We understand that we may have an additional opportunity to testify on this issue at a hearing scheduled for June 11. We look forward to providing additional details.

WEATHER PROGRAMS

There is nothing more important to a general aviation pilot than the timely detection and dissemination of hazardous weather information. General aviation pilots fly "in" the weather. The airlines, with the exception of the critical arrival and departure phase, of course, fly "above" the weather. To AOPA members, weather information is not just helpful, it is potentially life saving.

The National Transportation Safety Board reports that weather has been a factor in approximately 25 percent of all general aviation accidents and a factor in 40 percent of all fatal general aviation accidents. The aviation accident rate could be substantially improved if accurate forecast and timely weather information were more readily available for both preflight planning and in-flight decisions.

Beyond safety considerations, weather is also the single largest contributor to delays, comprising nearly 60 percent of all delays in the ATC system. The erosion of weather services for all aviation users and FAA's failure to develop and deploy on a timely basis the available new technologies is the most devastating deficiency in the implementation of the National Airspace System.

From a general aviation perspective, our priorities for improved weather products include the ability to provide automated weather observations, heavy snow detection, accurate in-flight icing forecasts, and specific thunderstorm area forecasts. AOPA believes the development and implementation of these and other improved aviation weather products should be considered largely the responsibility of the FAA. In fact, many are currently in various stages of research and development but are underfunded and we urge this Committee to reverse the erosion of resources for these critical programs.

HUMAN FACTORS

In the early days of aviation, most accidents had mechanical or "airworthiness" related deficiencies as a significant ingredient. However, to the manufacturer's credit, aircraft structural failure is no longer a primary cause of the majority of today's accidents. Rather, it is the "human performance" of operators which is the most predominant challenge facing us in improving aviation safety.

FAA has, in our view, avoided addressing this reality since most of its technical expertise is invested in the hard science of "black boxes" and electronics. But a review of today's accident cause factors reveals that urgent advances are needed in the "soft sciences" which are human performance and medically based in order to achieve any significant future advances in aviation safety.

We have reached the point where another "black box" to address a perceived safety problem may be counterproductive and actually lead to operator overload. FAA should take an aggressive leadership role in addressing human factor elements in contemporary operations and devise research programs that promise to alleviate future accidents.

FAA has made a tentative step in this direction by recently publishing The National Plan for Aviation Human Factors. However, this plan is only an outline of candidate research programs and must be given birth through the allocation of funds for well-focused R&D programs. We believe this most recent FAA "national plan" provides a solid basis for tangible safety benefits as the R,E&D program moves into the 21st Century.

* * * * *

Mr. Chairman, this concludes our comments. I will be happy to respond to questions from the Committee.

Mr. **Valentine**. Thank you, Mr. Brown.
Ms. Matthews.

STATEMENT OF SUZETTE MATTHEWS, GENERAL COUNSEL, AIR TRAFFIC CONTROL ASSOCIATION, ARLINGTON, VA

Ms. **Matthews**. Mr. Chairman and members of the subcommittee, I am Suzette Matthews, the General Counsel of the Air Traffic Control Association.

The Air Traffic Control Association is a professional association of 35 years' standing which has as its goal advancements in the science of air traffic control. Its membership represents all aspects of the air traffic control discipline, from civil and military air traffic control specialists and airways facilities technicians who operate and maintain the Air Traffic Control System, to those individuals and companies who develop and produce the technology and equipment which supports the system, to the citizens, Government agencies, and airlines who use the system.

With me today is Frank L. Frisbie. Mr. Frisbie is Executive Director of Technical and Management Assistance, Inc. Mr. Frisbie also serves as Director of ATCA's Area 1, which encompasses the United States' northeast region, Canada, Europe, and Africa. With your permission, ATCA will submit its written testimony for the record of this proceeding, and Mr. Frisbie will provide short remarks on ATCA's behalf.

[The prepared statement of Ms. Matthews follows:]

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STATEMENT OF

THE AIR TRAFFIC CONTROL ASSOCIATION, INC.

BEFORE THE

SUBCOMMITTEE ON TECHNOLOGY COMPETITIVENESS

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

UNITED STATES HOUSE OF REPRESENTATIVES

May 16, 1991

Introduction

Mr. Chairman and Members of the Subcommittee, I am Suzette Matthews, General Counsel of the Air Traffic Control Association, Inc. With me today is Frank L. Frisbie. Mr. Frisbie is Executive Director of Technical and Management Assistance, Inc., and Director of ATCA's Area 1, which encompasses the United States Northeast region, Canada, Europe and Africa. ATCA is a professional association of thirty-five years standing which has as its goal advancement in the science and profession of air traffic control and aviation safety. Its membership represents all aspects of the air traffic control discipline, from civil and military air traffic control specialists and airway facilities technicians who operate and maintain the Nation's air traffic control system, to those individuals and companies who develop and produce the technology and equipment which supports the system, to the citizens, government agencies, and airlines who use the system.

ATCA appears before you today to provide its views on reauthorization of the Federal Aviation Administration's research, engineering and development program, and to urge you to ensure that FAA has adequate resources in order to meet tomorrow's air traffic control challenges, as well as today's pressing needs.

Low RE&D Funding Levels, Missed Opportunities

In hearings before this subcommittee during April of last year, concerned aviation organizations including ATCA urged

Congress to approve significantly increased funding for FAA research, engineering and development programs for the fiscal years 1991 and 1992. Advanced aviation technologies are the key to meeting expanding public need for safe and efficient air transportation services in ways which are both economical and environmentally acceptable. With the able leadership of this Subcommittee, Congress demonstrated its commitment to achieving a safer and more efficient air transportation system by authorizing a spending level of $260 million per year in fiscal years 1991 and 1992.

Appropriations for FAA Research, Engineering and Development during the FY 91/92 period have not, unfortunately, kept pace with increases approved in the authorizing process. The President's FY 91 budget proposed only $190 million--$70 million below the level authorized--for FAA RE&D; ultimately only $205 was appropriated. This was, however, $25 million more than the FY 90 enacted level. This increase continues an encouraging trend toward greater emphasis on aviation research, but the low level of RE&D funding overall jeopardizes the possibility of major advances.

Again for FY 92, the President's budget proposes $210 million for FAA RE&D--$50 million less than the authorized amount. If the Administration's $210 million proposal for FAA RE&D in FY 92 prevails, FAA will be forced to reduce its level of effort in some important and promising areas. For example, the Administration's budget proposal for FY 92 would cut funding for automated en route air traffic control ("AERA 3") research by one-half in the coming year. AERA 3 is exploring the application of high levels of automation to the air traffic control system. Efforts such as AERA 3 not only in the long run push the state of the art and advance the science of air traffic control, but in the near term generate valuable new concepts and solutions that can be extracted and applied to current problems, or used to enhance existing systems.

Cuts also are proposed for other worthwhile efforts such as capacity development, work on separation standards, and the advanced air traffic management system. Many of these projects are directed toward increasing the efficiency and capacity of the air traffic control system without significant additional investments in new airports and runways. With air traffic predicted to grow at the rate of two to three percent per year until the year 2002, applied research into these low-cost, high-payback technologies should be increasing, not decreasing.

In hearings on May 2, 1991 before the Subcommittee on Transportation of the House Committee on Appropriations, concerned aviation organizations including ATCA urged Congress to approve $260 million--the full authorized amount--for FAA RE&D in FY 92.

Current RE&D Activities

With the resources made available during the past two years, FAA has made significant progress toward expanding and refocussing its RE&D capabilities and activities. In this process, FAA is concentrating more on defining the early twenty-first century air traffic control system, and developing the advanced concepts and technologies that will meet future system requirements.

In addition to devising projects that address newly identified needs such as aging aircraft integrity inspection and better aviation security, FAA is intensifying ongoing research into promising capacity and safety enhancing technologies. These include aeronautical data link, improved airport surface traffic surveillance and automation, terminal ATC automation, advanced air traffic management, enhanced sensors and procedures allowing reduced separations between aircraft on final approach to landing, and improved aviation weather detection and dissemination.

The development work on many of these FAA RE&D projects--for example precision runway monitors, converging runway display or "ghosting" controller aid, and predeparture clearance--is nearly complete or approaching completion, and the products of those efforts soon will be bringing concrete benefits to aviation operations. Planning for other needed projects, such as the National Simulation Laboratory, is underway. Overall, FAA's RE&D efforts are producing needed, useful enhancements to aviation safety and efficiency, and are to be commended.

Future Air Traffic Management

FAA also has well underway an effort to define the desired air traffic control system of the twenty-first century, and the advanced concepts and technologies that will play a role in the future system. The results of this endeavor to date are embodied in an FAA paper "Concepts and Description of the Future Air Traffic Management System for the United States," published in April 1991. ATCA applauds FAA on the wide-ranging technical vision and excellent quality of this document. ATCA wholeheartedly endorses this valuable work, and supports continuation of this process on an ongoing basis. A living, evolving future system design can serve as a valuable foundation for FAA RE&D and F&E project planning. ATCA cautions, however, that accomplishing the ambitious vision depicted in the "Concept and Description" is not consistent with current levels of RE&D funding. Significantly increased levels of financial support must be provided by Congress if FAA is to meet the technological challenges implicit in this document.

Building an R&D Capability

FAA also has begun the process of building in-house RE&D expertise which will be necessary to meet the research, engineering and development challenges ahead. Previous years of austerity budgets and emphasis on final development of NAS Plan technologies have depleted FAA's in-house capability for research. Although with great effectiveness FAA has enlisted the support of other government agencies, academia and private industry to assist in aviation RE&D, a critical mass of skilled in-house experts must be maintained in order to spearhead and manage FAA's programs. The Administration's FY 92 budget includes an increase of thirty-eight positions for FAA's RE&D capability.

Opportunities Which Can Be Addressed With Increased Funding

All of this worthwhile RE&D effort described above lays the groundwork for significant advancements that can be made possible through the application of adequate resources.

In the context of expanding cooperation with the Soviet Union, new opportunities are emerging for exploitation of satellites (GPS and GLONASS) for aviation navigation, as well as communication and surveillance. FAA research and development is well underway to bring increasing levels of automation to air traffic control terminal operations ("terminal advanced traffic control automation" or "TATCA"). This work not only will increase safety in the terminal area, but bears great potential for capacity enhancement and delay reduction. Products of TATCA efforts, along with advancements in automation of en route air traffic control ("AERA Services"), will be incorporated into the Advanced Automation System ("AAS"), bringing new levels of efficiency and safety to the air traffic control system.

FAA RE&D is on the threshold of significant advancements in cockpit technologies, such as synthetic vision and heads-up displays. Significant advancements also are in the offing for display directly in the aircraft cockpit of important safety and traffic management information derived from the air traffic control system and transmitted via data link, for example windshear alert, wake vortex, and clearance information.

FAA also is providing leadership in the use of advanced computer modelling and "rapid prototyping" techniques. Rapid prototyping allows a close interaction between operators and engineers in definition of requirements, and contributes to faster delivery of needed services and capabilities to the field. Using these techniques contributes toward accelerating development and testing of new technologies and procedures, and use of controller-

and pilot-in-the-loop simulation to test the impact of new ATC functional capabilities, enhancements, and procedures in air traffic control. FAA is proceeding toward establishment of a National Simulation Laboratory which will serve as the focal point for needed system integration and interoperability testing.

FAA must continue and intensify its research efforts to improve aircraft safety, including crashworthiness, fireworthiness, and aging aircraft testing and repair technology. New and better methods and equipment must be devised for protecting the flying public from terrorism, explosives, and other threats to aviation security.

Meanwhile, FAA must continue examination of human factors in aviation, and explore entirely new and advanced concepts and technologies which may in the future impact the air transport system, such as advanced telecommunications and sensors, hypersonic flight and the related Advanced Traffic Management System.

Encouraging the RE&D Momentum

The momentum is building for a truly vital, productive, dynamic FAA research, engineering and development program--a capability which will permit FAA to continue its leadership role in maintaining the preeminence of the United States in the world aviation community. ATCA urges Congress to fuel this momentum with resources--both human and financial--which are adequate to the challenge ahead.

To that end, ATCA urges the Congress this year to reauthorize funding for FAA's Research, Engineering and Development function for an extended period at a greatly expanded and increasing rate. Specifically, ATCA recommends that the new authorization period run from fiscal year 1993 to 1997, and that expenditures be authorized over that period which begin at approximately one and one-half to two times the current level, and which increase over the ensuing four years to approximately two and one-half to three times the current level by FY 1997. While this increase appears large in absolute terms, it is necessary in light of increasing demands on the air transport system, and reflects less than five percent (5%) of FAA's overall budget.

Thank you for the opportunity to present these views.

Mr. **Valentine**. Mr. Frisbie.

STATEMENT OF FRANK L. FRISBIE, EXECUTIVE DIRECTOR, TECHNICAL AND MANAGEMENT ASSISTANCE, INC., AND DIRECTOR, ATCA AREA 1

Mr. **Frisbie**. Thank you, Suzette.

Mr. Chairman, I will be brief.

As indicated in our prepared testimony, it is ATCA's view that the FAA R&D program is in need of an infusion of funds if it is to be revitalized to exploit technological opportunities.

The ATC systems coming on line today are the result of FAA R&D done in the 1960s and 1970s. Funds appropriated in the 1980s were largely used to bolster the NAS Plan, creating what I call a "research deficit." To meet the continuing routine level of support to the Air Traffic Control System and to match the demands of the future, an aggressive program is called for. Such a program must start with the support of this subcommittee and an appropriate authorization.

Too often in the past, FAA has not been able to share with the Congress its true desires relative to a robust R&D program because of constraints applied within the FAA itself and within other elements of the Executive Branch, constraints aimed at achieving a balance among disparate budget areas, but constraints, nevertheless.

This subcommittee has to recognize that each generation of civil servants that comes before you will be similarly constrained. Therefore, we urge the subcommittee to take a leadership role by giving the FAA and the appropriations side of Congress the freedom to establish and pursue the R&D program that the U.S. deserves in the form of a liberal and sustained authorization.

To accomplish this, ATCA is calling for an authorization period of five years, and funding levels growing from about $300 million to $500 million over the same period.

The advocates of aviation need to shed our self-imposed conservatism when it comes to R&D and to get on with the kind of program that I know this subcommittee supports and we in ATCA support.

Thank you, Mr. Chairman.

Mr. **Valentine**. Thank you very much, Mr. Frisbie.

Mr. Brown, the grounding of 90 percent or 50 percent of the general aviation fleet in this country because of the EPA standards is unthinkable, and that's not going to happen. It's an enormous challenge, however, to determine how to permanently avert it. What research, in your opinion, should be initiated to ensure the availability of fuel of the kind that will be acceptable now, or will be acceptable in the future, so that we can approach, at least, the standards for air cleanliness and still operate the Nation?

Mr. **Brown**. Well, there are primarily two areas that are needed, Mr. Chairman. The first, of course, is Government research that I alluded to. FAA should clearly take the lead here. There are a number of agencies of the Government, as you know, interested in clean air, less pollution, but FAA has the lead responsibility in aviation and this is clearly an aviation issue.

The work that they have done in the past, which was truncated due to funding changes and priority changes, should certainly be restarted immediately.

Secondly, the research that they had undertaken really was proving very productive and was pointing the way to some answers that looked very promising, so that needs to be concluded within a short time period.

Secondly, the private sector has ongoing research programs, and these should be encouraged and should be included as well. The manufacturers, as well as the refiners, in the petroleum industry are interested in preserving their market, and there are ongoing programs there.

Of particular interest to you, Mr. Chairman, is that you should know that at our conference there were representatives of refiners from Europe, particularly in Sweden, who are far ahead of the United States in finding answers to these problems. I see it primarily as an issue of U.S. leadership and competitiveness. If we can't find the solution first, then we'll be behind again.

Mr. VALENTINE. At this fuel symposium that I think you mentioned, what were some of the technology areas which were described there?

Mr. BROWN. The primary barrier, Mr. Chairman, is the octane level, or the performance level, of the fuel. The octane or performance level of fuels for general aviation aircraft engines has to be far in excess of that for automobiles or other ground vehicles for reasons you can well appreciate. You need a very reliable engine that performs well when you're not on the ground, and it has to meet high standards for certification.

So finding the additives, other than lead, that will produce that kind of performance, safety factor, and standard of performance is what is critical.

Mr. VALENTINE. What's the average age of an aircraft engine?

Mr. BROWN. Well, aircraft engines are replaced at periodic intervals. It is difficult for me to say precisely, but a general estimate would probably be in the range of seven to eight years for an aircraft engine.

Mr. VALENTINE. It would be difficult to find anybody amongst your acquaintances or mine, or anybody in this room, that drives an automobile that long.

Mr. BROWN. Well, I guess part of the answer to that, Mr. Chairman, is that airplanes are built better than automobiles, they last longer, and they are used differently. They are not used as many hours a day as an automobile. They don't drive through as many potholes—at least, I don't fly my airplane through as many turbulent, broken-up areas as you will find on the surface of a road. So the environments are very different and the integrity and the standard of the vehicle is very different.

Mr. VALENTINE. You don't mean to suggest to us that the undercarriage, the tires, of an average automobile are exposed to more pressure from time to time than the tires and the undercarriage of an airplane? Some of those things that I've ridden on seem to be not landed but a controlled crash. [Laughter.]

Mr. **Brown**. I guess you should fly with more general aviation pilots, Mr. Chairman. We land at lower landing speeds and at friendlier airports. I think our record is a little better.

Mr. **Valentine**. Well, don't ever fly with a Congressman. You know what the odds are; 2 in 2,000 elsewhere, 2 in 200,000. Perhaps that's poetic justice.

Let me return to the paper and be brief.

Mr. Frisbie, can you give us an assessment of the status of NAVSTAR or GPS, and when do you think it will be of any significance in the civil aviation arena?

Mr. **Frisbie**. Mr. Chairman, I think we've heard here today something that I find encouraging. My particular concern has to do with the availability of the maximum accuracy from the system. I'm not sure whether or not we heard too much about that today, because if the maximum accuracy, the so-called "P Code," were available, I think that it would draw people to the system at a much more rapid rate.

Notwithstanding that, Mr. Chairman, the system has achieved a great deal of popularity. I think Mr. Colson and Mr. DelBalzo both talked about some of the things that are going on, Northwest Airlines now flying some GPS routes, and so forth.

I think that the first significant impact will be felt in the oceanic areas, where there really isn't any competition for navigation, so I would look forward to the combination of GPS with communications satellites to provide automatic dependent surveillance over, for example, the North Atlantic, which would increase the availability of optimum routes for more and more aircraft over the North Atlantic. I would think that that is achievable within the next five years or so.

In terms of impact in the CONUS, I think that will be determined much as many of these cooperative systems are determined, Mr. Chairman, by the cost of avionics, and people—private pilots and commercial pilots—deciding whether or not the price of the avionics will give them significant benefit.

Mr. **Valentine**. Could you explain the difference between the GPS' degraded civilian C Code and the precision P Code, which is, of course, reserved for the military?

Mr. **Frisbie**. Yes, sir. The P Code is about 16 meters accuracy, whereas the C Code is about 100 meters accuracy. The difference, obviously, is that an aircraft using the currently restricted mode can do things someone using the open mode could not. In terms of nonprecision approaches, for example, I think it is widely acknowledged that with the P Code, the GPS could substitute for landing aids at many locations.

Mr. **Valentine**. Is it then important to civil aviation to eventually gain access to this precision——

Mr. **Frisbie**. Yes, sir, I think it is. I had an off-line conversation with Mr. Colson and he tells me that FAA, NASA, and DOD are looking at that possibility right now. So I am encouraged by what I've heard here today.

Mr. **Valentine**. In your opinion—this is a big question; you might not be equipped to answer it—do you have an opinion as to the approximate cost to equip the Nation's airports with localizers or with ILS?

Mr. **Frisbie**. The cost of an ILS is about a million dollars a location, which is the equipment cost. ILS, as you know, also requires site preparation. So on an individual site basis, it is probably $2 million or $3 million. That's the capital cost. There is a recurring cost associated with any installation of that type, whereas in a GPS environment—or for that matter, in a Loran-C environment, which we see now in the U.S.—the signals "rain down from the sky," so to speak, and maintenance of the kind we're talking about is not required, nor is site preparation required.

Mr. **Valentine**. That $1 million, is that—and I know you expanded that to $3 million or more—is that going to be the cost at every airport regardless of size? Or does the size of the airport have that much to do with the cost?

Mr. **Frisbie**. It's not the size of the airport so much, Mr. Chairman, as the extent of service that is intended. So a full Category 3 system is a system that probably costs three times as much, maybe, as a minimum Category 1 system. But as I suggested, the capital cost of the equipment can sometimes be swamped by the cost of site preparation and other factors.

Mr. **Valentine**. I have one final question that I forgot to ask Mr. Brown.

As a matter of general information, you referred to the availability—or airplanes being equipped to receive weather information, and the difference between how commercial airlines look at the weather and general aviation.

What percentage, approximately, of airplanes that are in that broad category of general aviation would, in your opinion, be equipped to receive any kind of sophisticated weather information?

Mr. **Brown**. In general aviation the weather is received almost exclusively by voice over VHF radios. There are some small percentage of the aircraft that have their own on-board radars or other weather detecting equipment, but the vast majority is simply by voice, and then the knowledge is applied on the part of the pilot.

In the vast majority of the cases, of course, the airlines have a greater percentage of radar and other airborne detecting equipment. In the future, of course, Datalink will provide much more concise hard copies, graphs, and other kinds of information in the cockpit to both airline crews and to general aviation pilots, as well.

Again, it's a function of what Mr. Frisbie discussed, the ability to buy the equipment and install it based on price and other factors.

Mr. **Valentine**. Of course, you're talking about something more than just a hand-held receiver. You're talking about equipment where—a two-way radio hookup?

Mr. **Brown**. Exactly. And, of course, in general aviation one of the most critical factors, in addition to price, for the equipment is the size and weight of the equipment. So if in fact it is rather large and bulky in a small aircraft, you can't afford to find the space to put it in. That's not as much an issue with the larger commercial aircraft.

So there is quite a bit of research that is going to be needed on this Datalink equipment and other types of weather information equipment to make sure we get to the point where it's affordable, and also small enough and compact enough that it can go in a small aircraft.

Mr. **Valentine**. Mr. Lewis?

Mr. **Lewis**. Thank you, Mr. Chairman.

Nice to see you, Mr. Brown, Ms. Matthews, Mr. Frisbie.

I was interested in your statement on human factors, Mr. Brown. This is, again, something that we all have a concern with. FAA has one person that is working on human factors; no one is reporting to him. I met this gentleman three years ago at Ames out in Los Angeles when he was with NASA doing human factors on the shuttle, and then he went with FAA. That shows you how far the program has progressed in human factors. It's very discouraging, and I believe it's up to this committee to make sure that, again, as you pointed out, we force the issue on human factors.

You pointed out what you felt was not enough money in long-term research and development, Mr. Brown, and I would like to point out just for the record, as we talk about this, we have $210 million in the current request for research and development. You're speaking of over $300 million. If we just take a look at the Airport and Airway Trust Fund of $15.5 billion, the 1990 interest alone on Treasury notes from 8¾ to 8⅞ would be $324 million, which would pay for the FAA's research. So just the interest alone.

I would like to ask—and I think it's a great point, and I also feel that FAA is way behind in its fuel research and not doing enough, and they have not been doing enough, and particularly in low flash points and self-containments. But I would like to ask Ms. Matthews and Mr. Frisbie, if I could, you heard me mention the Alcohol and Drug Research Program that is required under 101–508 for the FAA to handle long-term drugs and alcohol, on their technologies, to determine the impairment for pilots, air traffic controllers, and those in safety-critical positions.

Do you support this type of FAA research?

Ms. **Matthews**. Mr. Lewis, we are a professional association. The question you are directing at me is probably more properly directed to the union, which is the National Air Traffic Controllers Association.

Mr. **Lewis**. Why would it be any different in the union than in a professional association? Do you or do you not believe that we should have an Alcohol and Drug-Related Technology Program and research in the FAA for air traffic controllers and pilots?

Ms. **Matthews**. We agree that there should be a research program, but more than that, we don't have a particular, specific position on that.

Mr. **Lewis**. Okay.

That's really the only questions I had.

Mr. Frisbie, Ms. Matthews, thank you. Thank you, Mr. Brown.

Incidentally, I would just like to point out that my AOPA number is 89163.

Mr. **Brown**. We appreciate that.

Mr. **Lewis**. That may be before you were born. [Laughter.]

Mr. **Brown**. I'll check, but if I don't have to provide for the record, I would appreciate it.

Mr. **Valentine**. If you find out that's the case, don't tell him. He doesn't want to know. [Laughter.]

We have come to the end of another day. We thank you very much for the preparation that was involved, and we thank you for coming and sharing these thoughts with us.

With that, the subcommittee stands adjourned.

[Whereupon, at 12:10 p.m., the subcommittee adjourned, to reconvene at the call of the Chair.]

APPENDIX

**General Aviation
Manufacturers Association**

Suite 801
1400 K Street, N.W.
Washington, D.C. 20005-2485
(202) 393-1500

May 14, 1991

The Honorable Tim Valentine, Chairman
Subcommittee on Technology and Competitiveness
Committee on Science, Space and Technology
U.S. House of Representatives
Washington, D.C. 20515

Dear Mr. Chairman:

As you know, GAMA represents 31 American manufacturers of general aviation aircraft, engines, avionics, instruments, and other aircraft equipment and components. In addition to building over 80 percent of all aircraft flying in the U.S. today, GAMA member companies also operate aircraft fleets, airport fixed-base operations, pilot schools and training facilities across the nation. GAMA therefore has a great interest in maintaining a safe and efficient air transportation system under the effective management of the Federal Aviation Administration.

I would like to briefly discuss four GAMA concerns: FAA research into High Intensity Radiated Fields, or HIRF; FAA human factors research; the FAA's role in certifying aircraft engines; and structural crashworthiness R&D. First, HIRF.

High Intensity Radiated Fields (HIRF)

A little over two years ago, the FAA issued HIRF special conditions -- essentially rules that did not have to undergo the public scrutiny of technical and economic justification normally accorded FAA rules. These special conditions were applied to a number of airliners and general aviation airplanes. They affected all critical aircraft electronic components, requiring that the equipment withstand, without malfunction, energy fields as high as 200 volts per meter. FAA subsequently reassessed the radiated levels of high voltage transmitters, a reassessment demanded by the industry. In the absence of any indication of a problem, the FAA lowered the required level from 200 volts per meter to 100 volts per meter.

This level is based on the FAA's interpretation of "facts" alleged to have caused losses of military aircraft. These "facts" have since proven not to be true according to military sources. There were no civil aircraft incidents or accidents attributable to HIRF.

FAA recently conducted a limited test to determine the extent that HIRF fields actually interfere with critical aircraft systems. This follows a much more expansive general aviation industry test program to measure the impact of HIRF on general aviation aircraft. The FAA's test substantiated some of the industry results that indicated that HIRF levels actually reaching aircraft components were significantly less than FAA had speculated and that critical aircraft components could be completely protected from HIRF with measures far less costly than those required to meet FAA threat levels. To date, the FAA has not altered their position based on this test data. Clearly they will require additional testing.

We are concerned that funding for FAA HIRF testing has not been requested in the FAA's FY92 budget. The new HIRF certification standards have had a very onerous and costly impact on our industry. To retain such standards without adequate testing of their validity or applicability should be unthinkable. We recommend an additional $500,000 be added to the FAA RE&D budget for continued HIRF testing. We would also appreciate this committee taking action to ensure that adequate testing is conducted promptly.

Human Factors Research

We are also concerned that not enough research is being done on human factors in aircraft accidents. Nearly 90 percent of all aviation accidents are caused by human factors. Previous research on pilot decision making has demonstrated that pilots can be trained to make better decisions. If we are to make the air transportation system safer, human factors research that can be translated into effective regulations and training programs must continue to be pursued. The FAA's new Human Factors Plan is an excellent outline of worthy projects. Unfortunately, very little has been included in the FAA RE&D budget to support this plan. Moreover, the FAA needs to purchase a high fidelity general aviation flight simulator with state-of-the-art visual systems and motion for human factors performance research. This program is vital to preventing accidents and improving aviation safety.

Engine Certification

As a result of the recently-enacted Clean Air Act amendments, piston engine manufacturers will sooner or later be recertifying their engines to operate on unleaded fuel. The Environmental Protection Agency may very well rule that new aircraft engines are included in a post-1992 ban on the production of lead-burning "non-road" engines. GAMA is concerned that this early prohibition -- if imposed -- would not allow sufficient time to develop, test and obtain FAA certification for engine and engine/airframe combinations. GAMA, along with the rest of the general aviation community is working to ensure that new piston engine-powered airplanes may continue to be produced and sold in 1993 and beyond.

The issue that should concern the subcommittee is that the new clean air law does not make it clear that the FAA is the sole certifying government authority for aircraft engines. Historically, the expertise and responsibility for aviation engine certification has been within the FAA and it should remain solely their responsibility. For safety reasons, the EPA should not get involved in the aircraft certification business. We would appreciate any help the committee can provide in ensuring this responsibility remains with the FAA.

Structural Crashworthiness

Finally, crashworthiness tests on metal and composite airframes of commuter aircraft are important and should be fully funded. A better understanding of the interactions of the fuselage with the floor and seat structures under dynamic stress will lead to improved certification standards, performance specifications and -- of major importance -- improved safety for this category of aircraft.

We appreciate the opportunity to comment on the FAA's FY92 budget.

Sincerely,

James D. Gormley
President

cc: The Honorable Tom Lewis
Ranking Republica

May 21, 1991

Statement on behalf of

Aerospace Industries Association
Air Line Pilots Association
Air Traffic Control Association
Air Transport Association of America
Airport Consultants Council
Airport Operators Council International
American Association of Airport Executives
General Aviation Manufacturers Association
Helicopter Association International
National Air Transportation Association
National Association of State Aviation Officials
National Business Aircraft Association
Regional Airline Association

before the House Science and Technology Subcommittee on Competitiveness
on the subject of

FUTURE R,E&D NEEDS OF THE FEDERAL AVIATION ADMINISTRATION

Mr. Chairman and Members of the Subcommittee:

The above-listed members of the aviation community appreciate the opportunity to submit this statement for the record of the Subcommittee's hearing on FAA's R,E&D needs. This joint statement, presented by a number of aviation community organizations, is indicative of the united position and goals we hold for the National Air Transportation System. As we look toward the 21st century, the maintenance, improvement and expansion of the nation's airspace can only be achieved with the development and exploitation of new technology. Thus the Subcommittee's oversight hearings are an appropriate way to keep FAA on course to reach the common goals we all share.

As you know, the FAA FY-1992 budget request is only $210 million of the $260 million authorized by this Subcommittee last year. We look forward to working with you to insure that FAA's R,E&D programs are fully funded by the Congress.

In 1988 former FAA Administrator Najeeb Halaby, testifying on behalf of a number of aviation groups before the House Subcommittee on Aviation said

> **"The secret to success in a high-tech operation has always been innovation and adaptation. If the United States is to continue to lead the world in aviation and its safety, we simply must be willing to alter our approach to the FAA in order to accentuate its ability to adapt and innovate. It must be able to respond on a real time basis -- not years or even decades after technology has passed it by.**

FAA Research and Development is just reviving after a period of years in which the NAS Plan needs predominated. FAA top management is trying hard to rejuvenate real R&D. The shortage of qualified FAA experts and the procurement/acquisition problem which makes innovative R&D difficult continue to hurt. Here also, perhaps even more than in the F&E efforts, system integration is crucial, and the path to the future system must be made a part of many R&D projects.

FAA Progress to Report

From the perspective of the user community there is progress to report:

FAA Administrator Busey, with help from a less intrusive and more helpful DOT, has started to build an organizational structure and a management team which has a fighting chance to improve the system. The current FAA top management team for R,E&D is clearly focussed and, we believe, is capable of creating a useful R&D effort in FAA.

The Administrator has recognized the critical shortage of competent qualified people in the technical areas of FAA, and has taken encouraging steps to begin rebuilding a long-neglected work force. In the past year FAA was authorized to initiate hiring a significant number of technologists and high-level technical managers to augment the badly weakened and deteriorated work force.

After a number of false starts over several years, there is now hope for a coherent R,E&D Plan which responds to widely accepted priorities and which will track the Administrator's Vision of the Future System. It should be able to lead FAA to the development of new technologies for the future.

FAA is in the process of establishing and giving clout to a much-needed system design and integration group to help create a coherent system for the future.

FAA has embraced recommendations from a variety of sources in the areas of human factors, aircraft safety, airport and system capacity enhancement, and airport-related R&D, and is attempting to respond positively to them in the program it is developing.

FAA has responded positively to a number of the specific recommendations of its Research and Development Advisory Committee.

A Vision of the Future System

Perhaps most important, from the perspective of this hearing, the FAA Administrator has released his Vision of the Future ATC System, and in consequence a document entitled Concepts and Description of the Future Air Traffic Management System for the United States has been published. More comment on this all-important matter later in our testimony.

Support for an FY-1992 R,E&D Appropriation of at least $260 million

The progress being made, rather than the FAA FY-1992 budget request justification prepared a number of months ago and not a good indication of the present situation, leads us to support an R,E&D appropriation of $260 million. In Attachment 1 to this testimony we identify a series of specific proposed increases, but we believe FAA should be invited to offer an R&D program which permits rapid evolution and improvement of the system, unfettered by rigid funding limitations. The orderly development of the innovative system, of the future will require a larger R,E&D effort in coming years.

Our support for FAA's efforts and for a growing R,E&D budget is contingent on further progress on a number of problems which remain serious:

1. Strengthening FAA Staffing

One of FAA's most significant continuing challenges is the strengthening of its technical staffing. Although FAA has enlisted the support of other government agencies, academia and private industry to assist with aviation R&D, a critical mass of skilled in-house experts must be maintained to spearhead and manage FAA's programs.

Over the past year, FAA has taken advantage of flexibilities already available in the federal civil service system in order to employ a small number of scientists having specialized, needed expertise. In addition, the Administration's FY-1992 budget proposal includes an increase of thirty-eight (38) positions for FAA RE&D capability. The aviation associations applaud FAA on these initiatives.

We are also encouraged by enactment of the Federal Employees Pay Comparability Act of 1990, which makes government-wide improvements in federal civil service procedures, including locality and incentive pay increases, special pay rates for superior candidates, reimbursement of travel and relocation expenses of new appointees, and flexibility to reemploy military and civil retirees to meet exceptional needs. This new legislation will provide FAA additional opportunities to attract and retain employees with superior qualifications and performance records.

We will continue to work with FAA and the Congress to identify other management and legislative initiatives which will enhance the attractiveness of careers within FAA.

Najeeb Halaby, on behalf of the aviation associations in 1988, also quoted above, said

> "It must be recognized that the FAA, as an extraordinarily advanced, high technology organization, has a correspondingly extraordinary need to recruit and retain the highest quality engineers, software designers and scientists. Under the present salary structure and hiring rules this is simply impossible, and the agency must constantly and unsuccessfully scramble to keep up....Were the FAA free to set salaries on the basis of market conditions -- as it must to compete for these limited resources -- its return on investment would be

> **immeasurable....The FAA is not well served by the current complex, rigid personnel classification system, nor a government pay structure which is not conducive to the use of rewards and incentives. It is not well served by personnel ceilings which reflect budgetary and political factors which override work and safety demands. It must be freed of restrictions on use of retirees, free to provide special pay plans for unique employees, and free to design and fine tune its hiring and personnel rules to the needs of a unique agency."**

2. The Procurement Process for R,E&D Must Be Improved

The rigidity and complexity of the procurement process for R,E&D is perhaps even more of a problem than it is for F&E.

The procurement rules and practices, built up over many years, are intended to be scrupulously fair, to protect against fraud, dishonesty or favoritism by the government people involved. The process has gotten so complicated that it is no longer effective. While the intent is to assure well-considered government spending and high-quality, when R&D or equipment is procured during a technological revolution, flexibility to adapt to change is crucial if the government is to get its money's worth.

- It is a fiction that quality high tech equipment or R&D can be specified or bought in the rigid manner currently used in the procurement/acquisition process.
- Real R&D is stifled by rigid processes; R&D plans and their execution must be encouraged to be flexible and to adapt and change instantly and without penalty when the work reveals to the developers and managers that a change of course is indicated.
- Congress could help by encouraging a contracting and budgeting process which recognizes the importance of flexibility and innovation based on new facts, and to encourage changes of direction when that is sensible.

3. The Transition from R,E&D to Practical Use

The difficulty of transferring products of FAA R&D into the operating system has long been noted and deplored. It is perhaps attributable in part to the fact that the FAA operating services and their management structures, having been exposed to the potential of new technologies and broader vision of the future, often reflect incorrectly as "requirements" their fascination with technology rather than their operational needs. This can result in introducing additional uncertainty and risk which will unnecessarily prolong the process of transition. Likewise, since there is often no discrete cost, schedule, performance visibility associated with the escalation of individual requirements, the operational impact of delay or of reduction in quantities because of the greater expense of a single unit by their pursuit is not explicitly confronted and accepted or rejected.

This is not a slur on the dedicated FAA controllers and specialists who have shown their mettle over and over again. FAA and its controllers are moving more traffic than ever before, and moving it with an entirely enviable safety record. But it is inevitable that the FAA operating services, faced with the pressures of today, will concentrate on today's problems. It is not sensible to expect that line controllers or their Headquarters graduates, taught to be pragmatic and concrete, would or could be aware of innovations technology could achieve, nor their cost in time and money. However, those on the engineering side of the organization who are responsible for system acquisition must be made to confront FAA top management of the operational and budgetary impacts of these choices. In addition, since engineers can be even more susceptible to the lure of the outer fringes of state of the art, their choices must receive equal or greater scrutiny.

In the final analysis, controllers and their spokesmen and managers must be expected to insist on the highest quality of technical support, and must have a strong role in assuring that the systems offered them work properly. But, they must not have an effective veto power over new innovations. A balance must be reached, but if the balance is tilted in the direction of simpler solutions, proven technology, fewer FAA-unique requirements, more attention to off-the-shelf solutions, etc., the transition to practical use will be shorter and far less painful for all concerned. A major effort is needed at the highest level of FAA to resolve this long-standing problem.

4. Rapid Progress is Needed on System Engineering

While there has been a solid expression of intent from FAA management, there must be rapid progress to institute a system engineering process in FAA, as recommended by the FAA Administrator's Research and Development Advisory Committee. It must provide a coherent process from system concept development by a broad-gauged FAA system design team to system implementation and use. (See a recent related recommendation of the FAA'S Aviation System Capacity Advisory Committee, Attachment 2). This process can and must function without the time-consuming and wasteful internal hurdles which have plagued the development and implementation of many NAS Plan systems, and which have created years-long delays in implementation of innovative ideas and developments.

Specific Recommendations for R,E&D for FY-1992

Given the promising beginnings, and assuming continued commitment to real progress on the issues described above, it is now necessary to fund the R,E&D efforts sufficiently to permit FAA to fulfill its promises. We believe this will require more than the $210 million the Administration has requested.

In the $210 million R,E&D budget request, highlights are $40.4 million for System Capacity and Airports (of which perhaps $25 million actually has much to do with achieving capacity, including $11 million for airport surface traffic automation, $11 million for terminal ATC automation -- the rest is modelling [about $7 million], pavement work, airport task force studies, etc.) $31.8 million for aviation security R&D, $32 million for aircraft safety and aging aircraft, $20+ million for human systems and aviation medicine, etc. Notable by their absence, no funds are requested for some highly promising wake vortex research, and none for further research into exploitation of the capabilities of precision runway monitors.

In Attachment 1 we have laid out a series of specific upward adjustments to the Administration proposal for FY-1992. An adequate budget for research and development is essential if the FAA of the future is to be a viable organization able to lead the way in the future. Thus, we recommend that the FAA FY-1992 appropriation for R, E&D be increased to **a minimum of $260 million**. Much of this work is not really research, but rather development for implementation. The bridge between R&D and implementation must be especially solid, and therefore the issues discussed in the body of the testimony deserve attention.

Initiatives to Achieve More System Capacity

Last year the Aviation System Capacity Task Force developed a series of recommendations to FAA on efforts which need to be pursued energetically to achieve badly-needed additional capacity in our airway and airport system. The recommendations were accepted and endorsed by the FAA's Aviation System Capacity Advisory Committee, which has now refined and expanded the recommendations. The adjusted recommendations approved by the Advisory Committee on April 10, 1991, are given in Attachment 2. While a number of the recommendations are near-term in nature, many others are intended to lead us to an aviation system which makes innovative use of new technologies and new procedures.

The Development of the Future System

We noted above that the Administrator has published his Vision of the Future ATC System, and in consequence FAA has published a document entitled Concepts and Description of the Future Air Traffic Management System for the United States. The concepts are broadly supported in the aviation community. The future system concepts have roots in the work of the widely accepted recommendations of the International Civil Aviation Organization's Future Air Navigation System Committee and RTCA's Special Committee 155.

The Importance of New Technologies in the Aviation System

A number of new technologies which will have an impact - technologies such as digital communication for improved information interchange and automation aids for pilots and controllers. These new technologies can simplify the problems and the economics of handling a growing number of aircraft. Perhaps the most important technological opportunity is the use of the new capabilities for system integration and interaction and the enabling technology - data and voice information transfer and exchange - to increase capacity and reduce congestion of airspace and airports.

In considering ways to achieve increased capacity and reduce congestion, airport and airspace capacity must be treated as a single system resource requiring integration and optimal interaction between system elements as well as between aircraft and the ground infrastructure and the people who build and operate them. Major beneficial changes in the relationships between the human operators of aircraft and the ATC system, between human operators and their machines and technology, and in the development and use of procedures, can be achieved.

Improvements in the communications, navigation and surveillance (CNS) functions of the technical infrastructure are important, but improvements in the air traffic management process and the use of specific technologies for the achievement of optimum capacity increases are equally vital ingredients. More and more, air traffic management must be viewed as a process which encompasses the aircraft and its operational control function, the airport and the ATC system, with the elements integrated so that advantage may be taken of all available capabilities.

Grasping Rapidly Evolving Capabilities

The world is in the midst of a technological revolution, one which aviation must grasp rapidly and in harmony if the available benefits are to be achieved.

Among the elements of the revolution are:

♦ The dramatic evolution in computers and communications technology is the basis for the rest. Satellite communication technology is opening possibilities long wished for over oceans and sparsely populated areas and may well apply to other uses as well.

♦ Satellite navigation has created major opportunities for aviation (and all transportation) all over the world, over oceans, in less developed parts of the world, and in providing high quality approach guidance to any runway end anywhere in the world, without ground aids.

♦ ATC digital communications, or data link, a technology waiting to be used in aviation for many years, will be a major boon in using ATC computers to full advantage, in providing safety by reducing the problem of misunderstood communications and, most important, in connecting the formidable capabilities of aircraft systems with the ground ATC automation system.

♦ The technology developed for the airborne collision avoidance system, in itself a major safety tool, is available to create, in the cockpit, a valuable picture of the traffic situation around the aircraft. Working with the ATC system, such capabilities can lay the basis for a far better and more cooperative ATC process.

♦ The flight management systems increasingly available in modern transport aircraft can facilitate major improvements in working with ATC to create optimal flight profiles.

♦ Air traffic control automation technology, long in incubation, can create major improvements in the system.

♦ The world's air traffic surveillance system is limited in capability, and new technologies -- Mode S Secondary Surveillance Radar, satellite and terrestrially-based Automatic Dependent Surveillance, new surface surveillance tools, and fast-scan radar, are available.

♦ Vision enhancement techniques, long sought and researched, are likely to play an increasing role in airline cockpits. Giving crews a chance to "see" heads up in low visibility conditions is every pilot's dream.

♦ Separation standards and the approach to setting them have not materially changed in many years. A new assessment is likely to offer important benefits to help make best and safest use of available system capacity.

♦ Better ways to acquire, disseminate and use weather and environmental data are ready. Major strides have been made in windshear detection in better gathering of winds aloft and on approach, and severe storm data. Relief from the impact of wake vortices, a major airport-capacity-loser, is near.

The Future System Concept

In developing the future system concept, a number of system elements will require harmonization. It is important to provide greater freedom to aircraft to fly their preferred paths and profiles in a more cooperative ATC system, rather than being restricted to rigidly established routes. There must be a uniform, harmonized, boundary-less air traffic management (ATM) system. Automation will play a major role in the future system, but in different ways for high-density and low-density traffic situations.

♦ The FAA concept envisions a valuable future satellite and terrestrial communications and data link architecture.

♦ It postulates a Global Navigation Satellite System (GNSS) using elements of satellite navigation services (made up of US and USSR and possibly other satellites) able to provide a high-integrity, highly accurate navigation service. This service will have the capability to provide for non-precision approaches and eventually near-Category 1 or possibly better precision approach capability to any runway end in the world with no or only minimal ground aids.

♦ Future air traffic surveillance will consist of the SSR Mode S secondary radar system plus a "pseudo radar" automatic dependent surveillance (ADS) system in which quality aircraft-derived navigation data, unmodified by the crew and integrity-protected as far as possible, will be transmitted to the ground ATC system via high-quality satellite or terrestrial communications data link. This service, intended for over-ocean operations, sparsely inhabited land masses and less-busy areas where primary and secondary radar can't be economically justified, has the potential of making such airspace usable almost like domestic radar airspace.

♦ FAA has recognized the importance of airport capacity limitations and, with its Advisory Committees, has identified a series of technology and procedural initiatives for the achievement of increased capacity (see Attachment 2). These efforts include techniques to better cope with the effects of wake vortices, to achieve better information on weather and winds, to help air traffic control service providers to work with users to adapt dynamically to changing conditions, to provide independent arrival or departure streams, to apply new tools and procedures to reduce separation standards safely, and to use automation aids and services to achieve higher sector throughput capacity and reduce inter-arrival variability.

Airport and system capacity technology, as noted above, will offer important gains in both safety and capacity. These technologies are applicable to the busiest airports but many offer special benefits to developing regions and airports. Human factors issues will continue to be crucial for both controllers and pilots.

For very high traffic areas, where it is essential to take advantage of all available capacity of terminal areas and the enroute and transition sectors which feed them, it is important to develop strategic traffic flow control management tools. The opportunity is available in the technology to use computer data processing help to achieve improved coordination among ATC facilities, and with aircraft operators and airports to achieve rapid dynamic adaption to changing local conditions.

The growing ability of aircraft operators to decide on optimum flight paths and to execute them accurately (and with knowledge in the cockpit of nearby aircraft of concern) can offer greater ATC flexibility. Ability to accurately plan and follow flight plans and communicate automatically with the controller and his tools, will make ground automation essential. It will permit air traffic control to be conducted using enroute and terminal automation systems, with flow control and an overlay capability when needed.

Flow management and control systems, en-route and terminal automation systems, often developed separately because of the difficulty, must be technically and philosophically integrated. There are technology efforts under way in several states to develop advanced automation tools for the en-route and transition ATC process and for air traffic management. While the developments of enroute automation, terminal automation, and flow management automation are frequently carried out separately, tight integration is essential.

Conclusion

The Administrator's vision and the subsequent elaboration represents a valuable blueprint for the future R&D program. In releasing this vision of the future system, the Administrator has triggered the important process of pointing FAA's programs to a future in which the technological miracles which are within our grasp can be brought to reality -- hopefully with the United States in a leadership role. The aviation community as represented by our several associations stands ready to support the important and undoubtedly larger FAA R&D effort needed to bring this future vision to reality.

Attachment 1

Proposed Additions to FAA's FY-1992 R,E&D Appropriation Request

In the category of System Capacity and Airports, we believe the following adjustments are appropriate:

Airport Pavement R&D, to move toward a new universal pavement design methodology, the building of new and instrumented test pavements, and the long term data gathering and proof testing of new concepts and methodologies,

--	increase the requested $1.796 million to $6 million, an increase of	**$4.2 million**

For further exploitation of the capabilities of the Precision Runway Monitor System, and a specific study of the value of increasing the accuracy and update rate of terminal area surveillance,

--	increase the requested zero amount to	**$3 million**

For initiation of a revitalized effort to ameliorate the effects of wake vortices,

--	increase the requested zero amount to	**$5 million**

For an analysis and demonstration of the value of TCAS technology and cockpit traffic displays to achieve safe increases in terminal area capacity,

--	increase the requested from $5.218 to $7.218, an increase of	**$2.5 million**

For an increase in the extent of effort and the time required for completion of development of real terminal area automation and ghosting display applications,

--	increase the requested $11.02 million to 12.5 million, an increase of	**$1.5 million**

For an intense high priority effort on satellite navigation, so as to facilitate utilization of the U.S. Global Positioning System (GPS)/ICAO Global Navigation Satellite System (GNSS). Development of ground differential stations, integrity monitoring, verification of autonomous integrity monitoring, carrier phase measuring techniques for high accuracy applications should be part of such an effort, which will require an

--	increase in the requested $2.6 million to 12.6 million, and increase of	**$10 million**

For the support research and development for the system engineering design of the future system, especially for the integration of the various FAA automation efforts and flow management/control projects,

-- increase the requested zero amount to **$4 million**

For intensifying the work to conduct simulations of future systems and future procedures in a capable laboratory environment, in such a way that already existing laboratory facilities are utilized and integrated whenever possible, and in a manner that the specific developments and simulations are clearly identified and justified before major expenditures are incurred,

-- increase the requested $4.045 million for the National Simulation Laboratory to $9 million, by **$5 million**

To increase the emphasis on introduction of enroute automation into the ATC system, and to assure smooth transition from enroute/to terminal area/to on-airport-surface automation,

-- increase the requested amount of $3.846 million for AERA to $5.846, an increase of **$2 million**

To increase the emphasis on exploitation of new concepts and technologies for airport surface traffic management as may be identified during FAA's runway incursion system study effort,

-- increase the requested amount of $11.121 million for airport surface traffic automation by **$3 million**

To strengthen FAA's efforts in explosives detection, with special emphasis on the feasibility of new approaches and new technologies,

-- increase the requested amount from $23 million $28 million, an increase of **$5 million**

To strengthen FAA's efforts in airport security R&D, with emphasis on efforts to determine the effectiveness impact and cost of enhanced security through operational demonstrations and advanced modelling techniques,

-- increase the requested amount from $2.5 million to $4 million, an increase of **$1.5 million**

To step up the effort to develop procedures and models for identifying and countering threats to aircraft and airport facilities from a system perspective,

-- increase the requested amount for Security Systems Integration from $1.812 million to $ 2.812 million, an increase of **$1 million**

92r&dval

FEDERAL AVIATION ADMINISTRATION
AVIATION SYSTEM CAPACITY ADVISORY COMMITTEE

May 1, 1991

AIRPORT/AIRWAY SYSTEM CAPACITY TECHNOLOGY AND PROCEDURE DEVELOPMENT NEEDS

At the first meeting of the Aviation System Advisory Committee, the Committee endorsed the recommendations on Airport/Airway System Capacity Technology and Procedure Development Needs which had been developed by the earlier Aviation System Capacity Task Force, approved on August 22, 1990 and subsequently transmitted to the FAA Administrator.

On April 10,1991 the Aviation System Capacity Advisory Committee reviewed and approved the following expansion and clarification of its earlier recommendations.

Introduction

The following is a series of recommendations to FAA on ways to achieve additional airport and airway system capacity through the development and application of beneficial technology and procedures. They are an extension and update of recommendations made over several years by the Industry Task Force on Airport Capacity Improvement and Delay Reduction, augmented by recommendations developed over the past several months by the Aviation System Capacity Task Force. Both of these bodies are broadly representative of many expert elements of the aviation community.

The recommendations fall into two categories. The first is a group of recommendations to FAA top management on policy initiatives the Task Force believes should be undertaken. The second consists of numbered recommendations relate to specific projects which are recommended for early and energetic completion. It is understood that work on a number of these is under way, and the proposals may suggest changes in pace, direction, emphasis, or integration with other, related efforts.

The Time is Now

The necessary FAA work to achieve major gains in airport/airway system capacity requires only little R(research), but a great deal of D(development), implementation, procedure development, safety assessments, and training.

Rather than describing needed airport and system capacity efforts in terms of R&D required, the following describes the need in terms of the results needed. It is understood that the Congressional authorization and appropriations process requires FAA to break out and separately request authorization and funding for Facilities & Equipment capital investments and for Research, Engineering & Development, but FAA and the industry need to assure that this somewhat artificial division does not prevent a smooth flow of system improvements from development to implementation.

It appears to be a common notion that capacity technology work requires lengthy research and development. The demands of the system can not be met in this way. More than twenty years of research and development have created technologies which can have a major beneficial effect on capacity. New concepts should continue to be sought; but major gains are achievable by full exploitation of the technologies already identified. For R&D which is nearly complete and for the important exploration of new concepts, it is important to direct the work into areas with the most significant airport/airspace capacity payoff and to enhance the operational integration and acceptability of the work by having the system operators, maintainers, etc. participate in the process. The system engineering process, and the necessary continuity between the system concept, specification, development, implementation, testing, operation, maintenance, and modification need to be stressed as part of a successful R&D process.

In order to meet the need, the level of FAA effort should be such as to permit the identified capacity projects to reach first operational implementation in **three years as a goal** instead of the much longer time FAA has identified for most projects. It is understood of course that new and exploratory efforts will need to take longer.

Special budget and procurement authority may be needed by FAA in order to proceed at the pace recommended here. The Task Force believes the need justifies special authority.

Capacity is a System Problem and Requires a New FAA Approach

> **The formation of a high-level system capacity office was a good step and will be valuable if it is given the internal clout to act; and the new capacity management steering group led by the Deputy Administrator can be helpful if it insists on real output and timely integration of the projects into the system.**

Airport and airspace capacity must be treated as a system resource requiring exquisite integration and optimal interaction between system elements as well as between aircraft and the ground infrastructure and the people who build and operate them. Far higher levels of data processing and rationalization than have currently been considered will be needed. Major changes in the relationships between the human operators of aircraft and the ATC system, between human operators and their machines/technology, and in the development and use of procedures will be needed.

The traditional compartmentalization of FAA's functions -- of development, implementation, procedure development and safety assessments, all done separately, and the practice of breaking development tasks into many elements with only limited coordination -- may have been justifiable in the past, but will not serve in the future. An entirely new approach without administrative "walls," staffed by a critical mass of engineering, ATC, procedures, safety, and computer science experts, working closely with airspace users and airports, but led by system thinkers and integrators, is needed if the safe beneficial integration of available technologies is to be achieved.

A New Partnership Between FAA and Users is Needed to Adapt the ATC System Dynamically

> **A clear policy decision by FAA is needed to exploit new capabilities that can create highly valuable improvements in the effectiveness of the air traffic control system. These techniques would not negate current modernization efforts but would enhance them. Airport capacity as well as airspace system capacity and efficiency could be enhanced.**

There must be emphasis in the work to increase capacity, on the terminal area, on the enroute and transition sectors which feed them, and on the more strategic traffic flow control management tools. There is a need for computer data processing help to achieve improved coordination among FAA facilities, and with airlines, airports and other users -- particularly as ATC Center traffic situation displays, potentially real-time analytical capabilities like an evolution of NASPAC to a real time tool, the NAMFAC effort , and improved real-time weather data becomes available-- so as to permit rapid dynamic adaptation to changing local conditions.

The need for capacity, efficiency, and the need to make best use of scarce resources, along with the growing ability of aircraft operators to decide on optimum flight paths and to execute them accurately (and with knowledge in the cockpit of nearby aircraft of concern), will inevitably push ATC into greater flexibility. Ability to accurately plan and follow flight plans and communicate automatically with the controller and his tools will make ground automation essential. It will permit ATC to be conducted via using enroute and terminal automation system (like FAA's AERA and TATCA developments), with flow control as an overlay capability when needed.

The important point is that the Air Traffic Management process must be viewed as a system which encompasses the aircraft and its operational control function, the airport and the ATC system, with the elements integrated so that advantage may be taken of all available capabilities.

Focus on the Major Gainers

> **FAA activities should concentrate on tasks which show promise of yielding increases in the direct, intrinsic, maximum achievable capacity.**

This emphasis casts no negative reflection on other necessary FAA work, but identifies the tasks which are considered to have the highest payback in terms of direct, full-time airport/terminal area capacity.

The work should concentrate on tools and procedures for the reduction in lateral or longitudinal spacing requirements, tools to better cope with the effects of wake vortices, to achieve better information on weather and winds, the development of the ability and the communications to work with users to adapt dynamically to changing conditions, the ability to provide independent arrival or departure streams, and the ability through automation to achieve higher sector throughput capacity and reduce inter-arrival variability.

A Creative Environment for Ongoing Technological Innovation needs to be maintained.

Many of the system capacity initiatives currently identified will create new opportunities to adapt and fuse technology to achieve additional safety, efficiency and capacity benefits. The ability to favorably affect basic national air transportation system standards, criteria and procedures can be the basis for substantial and cost effective progress to maintain aviation's transportation preeminence.

For example, an adaption of the new Precision Runway Monitor radar system, which improves current radar surveillance updates and resolution, may permit reduction of terminal radar separation standards. Fusion of this radar system with the cockpit traffic displays and with the almost instantaneous communication capability of data link may further aid to reduce terminal, as well as, enroute radar separation standards.

It is Essential for FAA to Utilize Innovative Data Processing and "Outboard" Processors

> **FAA management should immediately establish a policy that encourages use of innovative ways to recapture or create new computer capacity, including "outboard" data processors and displays to achieve useful capacity and system efficiency ends. FAA should rapidly establish the criteria for safe use of such systems.**

It has been a dogma for years that real ATC innovations that require FAA computer capacity must await the implementation of the Advanced Automation System and its new computers and advanced controller suites. Since these were years away, there was a feeling of leisure and comfortable study time for any potential real automation -- "human-centered" or not -- since implementation was always far off. This comfortable dogma avoided the practical (even if sometimes not neat) approach of using innovative ways to achieve needed computer capacity, including "outboard" computers, data processing and perhaps even display systems to actually accomplish a desired end. Since virtually all the computer automation base systems will now appear years late, the dogma (and excuse for inaction) should not be allowed to stand.

Policy Determinations Needed

> **A basic philosophical determination is needed on the relative emphasis to be placed on flow control, essentially a "wholesale" way to manage air traffic, and the more fine-grained "retail" management which systems like the AERA and the terminal automation concepts will make possible to the benefit of individual aircraft.**

The high emphasis on traffic management, which gained much deserved praise during the controller strike because of the ability to match demand to capacity, has taken the emphasis from other automation systems that may increase capacity and has permitted a fundamental philosophical dilemma to go unaddressed for years.

The function of air traffic management has an inherent responsibility to seek procedural initiatives to increase enroute and terminal throughput and to ensure that precious capacity is used efficiently.

Flow control is a demand management tool, and its limitations must be recognized. As a strategic management tool it is no better than the ability of the system to forecast conditions, and conservatism in forecasting results in a loss of usable capacity.

Airspace issues related to air traffic flow management and ATC process automation for enroute and terminal area control are crucial to the efficient use of both airspace and airports, and consideration of the two elements separately is not fruitful.

> **Experts seem to be in agreement that the automation tools that are likely to work and be useful are those that offer advice and assistance to controllers which controllers can evaluate and accept or reject.**

Efforts that have attempted to automate processes in ways that leave the controller "out of the loop" have not been successful. Initial ATC process automation efforts should concentrate on establishing the optimum interaction between automation and the responsible controllers and pilots. It is recognized however that in the longer term, it may become acceptable for certain ATC tasks to be performed automatically.

> **While it may be appropriate to carry certain ATC automation developments forward on several tracks, it is essential that an integrated system concept be established now. Tight integration as a policy is essential and must now be pursued vigorously.**

Enroute, transition and terminal ATC automation, flow control/automatic traffic management systems, oceanic automation, and airport surface automation must grow together into an integrated capability, and the integration concepts must be established now. Because of the difficulties of sustaining a large unified effort, various automation efforts have proceeded independently in the hope that something would result but the pace of progress to date has been very slow.

An Operational Concept Statement is Needed

In order to enable all elements of aviation to take best advantage of the initiatives described below, FAA is urged to create an operational concept statement and a plan defining the manner in which FAA envisions the integration of the new capabilities these projects can create within the air traffic control system. It is recommended that system users be included in the development. The concept and plan should show the manner and the degree to which it is expected to result in capacity gains to satisfy the projected demand. Accommodation of the most advanced airborne and ground capabilities available at the time must be considered, within an environment of widely varying capabilities. A time horizon of five years is considered appropriate for such an operational concept and plan, with an annual update.

The Needed Capacity Technology Efforts

The level of FAA effort should be such as to permit the identified capacity projects to reach first operational implementation in **three years as a goal** instead of the much longer time FAA has identified for most projects.

THE PROJECTS

1. **Reduce required spacing for independent precision approaches to parallel runways.**

2. **Reduce minimums for operations to converging runways.**

3. **Establish procedures for IFR operations to closely-spaced parallel, triple and quadruple runways.**

    ♦ Near-term Actions for Items 1, 2 and 3

    Complete development, installation, demonstration, procedure development and validation of high data rate and medium data rate sensor systems for closely-spaced independent and dependent parallel and converging runway reduced-minimums operations.

    Expedite airspace procedure development, simulation, validation and demonstrations for closely-spaced parallel and triple/quadruple runway simultaneous operations, reduced-minimums converging operations, wet-runway reduced minimums operations.

    Expedite the development of the technology, the operational guidelines and the ATC procedures necessary to support triple IFR dependent converging approach capability, and triple independent parallel approach capability. While new technology such as the Precision Runway Monitor (PRM) and the Converging Runway Display Aid (CRDA) may support triple IFR approach capability, early progress is needed on the air traffic control procedures necessary to fully benefit from this technology.

    Establish criteria and specific achievable minimums benefits from MLS or other navigation-based precision curved/segmented approaches and departures.

    Identify prospects, and potential changes to current ATC rules and procedures, which might permit additional simultaneous (independent) IFR departure capability through improved technology and procedures. Identify multiple-runway airports where simultaneous departures cannot be conducted due to noise problems, terrain, other airports, and ATC rules/procedures. Analyze extent to which improved technology (MLS, FMS, TCAS, improved surveillance, use of data link, etc.) could help achieve simultaneous IFR departures. As part of this work, analyze simultaneous arrivals/departures/missed approaches.

4. **Creation of additional computer capacity/memory for terminal operations.**

- Near Term Actions

As a highest priority, develop and implement additional capacity/memory for FAA's computer systems to permit terminal operations to be improved by use of available tools to aid controllers. Projects to increase needed system capacity should not be delayed to await the planned major FAA computer capacity increases. See also the policy recommendation concerning innovative data processing on Page 4.

5. **Introduce automation aids for controllers into terminal area operations to:**

    a. **achieve optimal arrival sequencing**
    b. **provide guidance for staggered and converging arrivals**
    c. **achieve minimum required wake vortex spacings**
    d. **reduce inter-arrival landing time variability by 50%**

FAA needs to reexamine and restructure its terminal automation effort to achieve first operational implementation on a fast track and without waiting for either full-system perfection or for the completion of development of large FAA computer/data processing systems. This would appear to be an especially appropriate application of the "outboard" data processing devices discussed above.

Because of the importance of gaining the airport capacity benefit of terminal automation to reduce inter-aircraft variability, and to achieve dynamic adaptation of necessary wake vortex spacings at an early date, these automation efforts should be pursued by themselves, and, while a part of a broader system scheme, should not be put in series with other efforts.

NASA has been working on a Descent Advisor/Sequence Planner, and the German Research Institute for Air and Space (DLR) has made major progress on their COMPAS system, as have the French with MAESTRO. NASA and DLR people have been working closely; FAA has also been involved. This work is advanced, and should be enthusiastically embraced by FAA to help make early progress, especially since these efforts have emphasized the importance of their advisory character, in which controllers are helped but remain fully involved in the control process.

FAA has engaged MIT Lincoln Laboratory to develop the TATCA project, which includes the clear responsibility to integrate the successful work of others who have been at work for many years on these topics, including earlier work for and by FAA and the MITRE Corporation.

- Near Term Actions

Development and validation of terminal automation tools should proceed for earliest possible stage by stage implementation of applications of "ghosting" (mirror imaging) applications, time-to-turn-to-final and final approach spacing advisory systems, dynamic wake vortex spacing adaptation, and a terminal operations planner.

Applications of "ghosting" to enroute and transition airspace merging traffic at feeder fixes should be considered for implementation at an early date.

Because a great deal of the promise of ATC automation depends on the successful introduction and use of digital air/ground communications, Recommendation 17 has special pertinence.

6. **Systematic and scientific analysis of enroute and terminal capacity needed.**

- Near Term Actions

FAA should immediately commission a systematic and scientific assessment of individual enroute sector and terminal capacity. The aim should be to streamline present enroute traffic flows utilizing heretofore unused capacity and form the basis for accommodating predicted increases in enroute demand.

Such analyses must include recommendations for resectoring, beneficial adjustments to enroute traffic flows, elimination or adjustment of mandatory preferential routes, and the elimination of many daily traffic restrictions. The use of parallel routes based on current flight management capabilities is one possibility.

ATC sector and area traffic flow and controller workload studies are needed to optimize sector design and to smooth operations in busy ATC sectors and areas.

7. **Early Completion and Transition to Initial Sector Suites Needed**

Expedite implementation of the initial sector suite subsystem at enroute and terminal facilities. Implementation at both of these facilities should take place simultaneously, or as nearly so as practical, with special emphasis on terminal area implementation.

8. **Develop requirements and procedures for use of cockpit traffic displays to provide better information to pilots on traffic situation and permit pilot participation in approaching VFR capacity in IFR conditions.**

Extensions of the TCAS technologies can be used to achieve greater ATC efficiency and capacity. Such extensions could lead to greater participation by pilots in a cooperative ATC process which involves a more effective level of shared responsibilities.

- Near Term Actions

FAA should undertake the development of procedures to exploit safely the use of such cockpit traffic displays and should undertake the development of minimum performance requirements for the aircraft systems to achieve most effective use of such displays.

Development of cooperative air traffic control procedures should be completed to coincide with the TCAS implementation.

FAA should identify any remaining issues which will promote optimum use of such technologies and to utilize the very extensive experience and expertise of NASA to bring the use of such displays to rapid and beneficial implementation.

For the longer term FAA should examine the potential of GPS/GNSS as a data source for cockpit traffic displays.

9. **Complete development/refinement of airspace and terminal area traffic flow analysis models and apply as appropriate to achieve more cooperative ATC.**

- Near to Mid-term Actions

Utilize the best available modeling tools to support airport-specific task force studies.

Adapt successful tools such as real-time Aircraft Situation Displays and dynamic models into mechanisms to dynamically adapt the ATC process in changing situations in cooperation with the airspace users. Explore possibilities of NASPAC technology to establish its proper application in this function.

10. **Continue and accelerate specific-airport capacity improvement studies and apply new technology concepts to establish their local application.**

- Near Term Actions

As traffic demand and flow patterns change and airports themselves change to cope with changing circumstances, an aggressive schedule of specific airport task force studies should be maintained by FAA and given the full measure of FAA resources to provide data and analyses of alternatives for airport and terminal area operations, and optimal connection to the enroute and transition system.

11. **Renew efforts to reduce operational impact of wake vortices.**

- Near Term Actions

a. Undertake an effort to gather wake signatures on all current aircraft, so as to minimize, by developing refined aircraft classifications, the need to use maximum spacings for lack of accurate data.

b. Undertake work to automate the use of wake vortex classifications and more refined aircraft data in displays and advisory systems (like early stage TATCA or the German COMPAS) so as to permit safe minimum separations to be established dynamically as part of early introduction of terminal automation.

c. Attempt to complete development of previously abandoned wake vortex detection and advisory system, adding the results of the work done by DLR (Germany) on turbulence detection, and tie the WVAS to other sensors to provide data further out on approach than WVAS alone can provide.

The system should be designed to meet ATC and operational needs for wake data at altitude, assurance of an adequate "green light" period, and an ATC operational doctrine.

d. Reemphasize the development of wake vortex sensing techniques in aircraft, along with the use of vision enhancement techniques and development of a control system response process to permit aircraft to sense and react to wakes, to permit them to close up on final when it is safe to do so.

e.. For the longer term there should be renewed efforts to eliminate wake vortices at the aircraft source.

12. Expedite development of procedures for beneficial application of MLS or equivalent systems to achieve precision arrival and departure paths.

- Near and Mid-term Actions

a. reduce operating minima commensurate with capability of MLS or equivalent capability

b. rapidly develop procedures for capacity enhancement by use of fully flexible approach, departure and missed approach paths, and development of least-noise arrival and departure paths

Gather actual current aircraft performance data near and on airports and during missed approach operations to permit use of realistic data in separation reduction studies (Use

data from efforts 1, 2, & 3 as appropriate).

13. **Improve safe on-airport air traffic movement and control, which can improve capacity by permitting efficient use of runways, taxiways, holding areas and aprons in all significant weather conditions.**

It is important to consider the matter of safe airport surface operations broadly, as a system issue. The matter of runway incursions is an important, but by no means the only, element of a much larger issue. The issue involves at least a) efforts to achieve better and more uniform runway and taxiway lighting and signage, b) improved on-airport visual guidance during both good weather and in Category 2/3 conditions, c) provision of better information to air traffic controllers through implementation of ASDE and its enhancements, d) better definition and policy decisions concerning the implementation and use of controller-operated stop-bars, etc. Finally there is the issue of whether and when real automation aids should be developed and provided at major airports for both the ATC system and controllers to optimize the operation and management of the airport resource. A part of that issue is the matter of establishing the best ways to integrate such airport surface automation into the terminal automation efforts getting under way in FAA.

The development efforts may break into two areas:

a. **development of an automated, airspace system-compatible airport surface surveillance, guidance and control system which supports improved runway incursion control.**

- Near Term Actions

As a first step, implement the long-discussed runway incursion monitor using ASDE-3 enhancements tied in with appropriate ARTS-3 data.

- Near to Mid-Term Actions

Develop Airport Surface Traffic Automation, utilizing earlier research and development to develop and demonstrate an airport surface surveillance, guidance and control system, implementable in steps and using the technologies used in the airspace system where practical.

b. **improving and standardizing airport lighting, signage and marking to provide for safer airport operations during runway entry and turnoff, departure and crossing, reduction of runway occupancy time.**

- Near Term Actions

Improve airport surface visual control to permit efficient taxiway exit operations.

Complete development, validation and procedure development for stop bars and hold-short systems for runway entrances, intersections and ends.

14. **Continue pavement design R&D to establish standard runway design criteria, improve pavement longevity, reduce impact of runway construction on airport operations, and obtain best value for AIP investment.**

Complete work to establish better data on runway friction and its operational relation to runway occupancy time.

- Near and Mid-Term Actions

Recommendations for well-focussed priority FAA R&D in this field has been supported by the Industry Task Force on Airport Capacity Improvement and Delay Reduction. The specific recommendations were transmitted to the FAA Administrator by the Airport Operators Council International on August 17, 1989.

Important capacity benefits can be achieved especially from research areas 3 and 4 of that document.

15. **The FAA aviation weather system must be substantially enhanced. Weather data, both near terminals and aloft, needs to improve dramatically. The safety-related weather information, such as wind shear, wake vortices, and thunderstorm, must be a priority. But effective terminal and enroute automation and sensible flow management all require the best possible weather and wind gradient information.**

It is well recognized that the capacity of the national aviation system is a strong function of weather and that today's aviation weather is antiquated. Weather programs must address the deficiency in timely and accurate detection and prediction of aviation weather.

- **Near Term Actions**

Timely completion and implementation of the National Aviation Weather Plan by the National Weather Service and FAA, which outlines needed improvements in collection and dissemination of aviation weather information, is imperative.

Expedite the development and implementation of advanced aviation weather products critical for the enhancement of system safety and capacity. Safety and capacity-related products should include high resolution information of the 4-dimensional wind structure,

CAT regions, convective areas to be avoided, terminal wind and shear conditions, icing and winter storm events.

Advanced aviation weather information must be user-specific and should be available to all appropriate FAA (FSS, ARTCC, ATCT, CFCF), industry (meteorology centers, dispatch), and airport facilities.

The group's views should be coordinated with the Weather working group of the FAA Research and Development Advisory Committee.

16. **Assure optimum civil/military airspace use. Continue efforts to dynamically release special-use airspace for use in the civil system as soon as the military use is no longer required. Support rapid completion of the Military Airspace Management System and assure its tight integration with the FAA centralized traffic management system.**

17. **Expedite the development of FAA ground hardware, software and procedures to make full use of digital communications.**

A number of the controller-to-aircraft and aircraft-to-controller communications (such as weather, sector handoff, frequency changes, and others) can be thought of as "routine communications." Important benefits can be achieved by using data link to minimize verbal communications and thereby reducing workload demand on controllers and pilots. More efficient transfer of information for communications, command, and control can reduce workload/related ground and airborne delays and potentially enhance safety.

FAA needs to establish a clear, system-wide agency policy for application of data link, to re-examine its command and control policies and its communications procedures and practices in order to take full advantage of data link. Because the industry is deeply involved in all communications processes, coordination of new approaches with he industry is important.

- Near Term and Mid Term Actions

Expedite FAA work to begin to utilize data link to help achieve higher levels of automatic cooperation between a more sophisticated ATC system and more capable aircraft systems.

Expand use of ACARS for clearance delivery beyond currently planned locations. Automated ATIS and transmission of weather data are services which can reduce the growing voice communications burden on pilots and controllers.

Complete development of standardized methods and formats to use a variety of data links (ACARS, satellite links, Mode S).

18. **Complete and implement oceanic improvements to increase capacity and efficiency of over-ocean operations.**

- Near Term Actions

Within a properly prioritized effort to increase airspace capacity in oceanic and remote areas, complete work a) to reduce vertical separation to 1000' above FL290; b) to implement hardware and procedures to derive increased safety, better traffic situation information for controllers, and reduced separation standards benefit from Automatic Dependent Surveillance; and c) to develop procedures to take benefit from the availability of TCAS and the TCAS cockpit traffic display technology.

Proceed rapidly to implement a satisfactory automated oceanic controller planning and display systems such as ODAPS and/or DOTS, with the ability to gather and utilize high quality weather and winds aloft data.

The system requirements and system functional characteristics must be closely coordinated with the programs of other ATC provider states. Automated oceanic ATC systems must be harmonized to ensure optimum use of the airspace and to create center/sector boundaries that are transparent to the users.

Complete analytical work to establish the basis for step-by-step reduction of oceanic separation standards.

19. **Demonstrate capabilities and develop procedures to exploit the capabilities of satellite navigation.**

The United States has embraced the concept of using space-based systems for the purpose of navigation. ICAO FANS has embraced a Global Navigation Satellite System (GNSS) concept which might utilize the satellites of several systems. The first system anticipated to become available will be the Global Positioning System (GPS).

Within the next three years, the U.S. Department of Defense will declare GPS operational. The high accuracy navigation capability of GPS, and of the ICAO-designated GNSS, has the potential of providing substantial capacity gains. The FAA must begin now to demonstrate the applicability of GPS and GNSS capabilities for civil aviation and develop procedures so that the systems can be beneficially exploited when the full system/s capabilities becomes operational. Experience gained with GPS will allow the rapid inclusion of other like systems if/when they become operational.

Until the full system/s are implemented and fully operational and their capabilities are fully demonstrated, the use of supporting/aiding systems is encouraged.

- Near Term Actions

Establish criteria for certification of satellite navigation as an autonomous (non-ground-aided) "sole means" of navigation when the system/s become operational.

Demonstrate and develop procedures for GPS-based and GNSS-based non-precision approaches.

Demonstrate and develop procedures for using satellite navigation-based curved/segmented approaches to ILS short finals.

Establish, through analysis and demonstrations, the potential of differential GPS and/or GNSS to support CAT I, II, III precision approaches.

Demonstrate ADS with GNSS as the navigation update.

Demonstrate the integration of GPS/GNSS into an aircraft flight management system for direct routing navigation.

Establish an FAA/industry effort (to include FAA Air Traffic Service, Flight Standards/procedures specialists, and the Satellite Program Office) to oversee the adoption and integration of satellite navigation capabilities into the ATC system.

Demonstrate the ability of the GPS/GNSS satellite navigation systems to provide positive guidance during missed approach procedures.

Create optimized FAA Flight Standards Terminal Instrument Procedures (i.e. TERPs) to realize timely benefits of stand-alone and aided/integrated satellite navigation systems.

Considering the capabilities of satellite navigation and other high accuracy navigation systems, establish the basis for reducing or eliminating TERPS requirements for independent IFR approaches to dual triple and quadruple runway configurations.

20. **Conduct analyses and development to identify means to reduce runway occupancy time.**

21. **Establish appropriate roles for vision enhancement techniques.**

- Mid Term Actions

Conduct an analysis of existing data from military and industry research and development to verify the capabilities of improved cockpit sensor and display technology for use in civil aviation cockpits. These technologies may help, by use of synthetic vision enhancement devices, to approach VMC system and airport capacity in IMC.

Concurrently, procedures for the use of such systems should be developed by FAA to provide for the use of this technology, if successful, to permit approaches to lower landing minima than are now achievable.

22. **Explore methods to increase capacity through the use of more accurate and more-rapidly-updated surveillance displays for controllers.**

FAA has clearly demonstrated the ability of high update-rate secondary surveillance radar to reduce the required minimum separation between runways for IFR independent approaches to parallel runways. It is possible that this same radar technology or different target tracking software may make possible a reductions in the required enroute or terminal area separation standards, and may thus increase capacity.

- Near Term Actions

Undertake a study to establish the capability of high-update-rate secondary surveillance radar (and primary radar if appropriate) to support reduction of separation standards.

Assess alternative target tracking software approaches that could provide more accurate and more frequent updates of target displays.

Establish the capacity gains to be expected from reduction of terminal area as well as enroute separation standards through the use of high-update-rate radar and/or advanced software display algorithms.

Determine the cost effectiveness of including these new technologies in planned new FAA specifications for secondary and primary radar, by comparing the increase in cost of such radar to the expected value of capacity gains.

23. **Examination of the Basis for Current Separation Standards and TERPS Criteria**

- Near Term Actions

While in recent years FAA has attempted to apply mathematical risk analysis to the development of separation standards, virtually all the standards in practical use are empirical and are based on the sound judgement of experienced operational experts. While analysis and mathematical risk assessments are valuable as guides, such analyses have not been successful in reflecting reality, and have inferred unacceptable risks in the use of standards which have been used with virtually perfect safety for decades. Similarly in current terminal procedures, the mathematical criteria applied to separate aircraft from ground obstacles would appear to yield unacceptable risks, but decades of use have proven otherwise.

These incongruities are serious when the fact is faced that the real impact of surveillance on the need for particular separation standards has not been analytically established, and that the early TERPS criteria for MLS, a system greatly superior to ILS, when mathematically reckoned, offered no apparent minimums credit for MLS.

Because procedures and separation standards have an important influence over the capacity and functioning of the future system, it will be necessary to undertake a practical assessment of current standards and how they are determined, and to develop a more rational method which more nearly represents actual experience.

Because radar separation standards have an important influence over the capacity and functioning of the future system, FAA needs to undertake a practical assessment of current standards and how they are determined, as a first step toward a more optimized set of standards and criteria based upon new and developing technological capabilities.

These standards should include terminal and enroute primary and secondary surveillance radar systems when used as stand-alone sensors, and as well when such sensors are used in conjunction with other systems (e.g. TCAS II) and procedures (e.g. TERPS).

24. Flow Management and Evolution to More Cooperative ATC

Study the flow management process to reach a common understanding of where and why flow restrictions are applied. Based upon this understanding, develop procedural modifications in two phases: First, modifications that may be accomplished within the existing architecture; second, those which may be made possible through the systematic integration of emerging new technologies in both aircraft and ground systems into a more capable architecture. Some of these technologies include, in the aircraft: data communications, flight management systems, 4-D navigation, and TCAS. Ground automation technologies are reflected in the automation programs, AERA, TATCA, ASTA, etc.

The integration strategy should be to view these technologies as a total integrated system, which has the objective of removing, to the greatest practical degree, restrictions to flight while maintaining the integrity of system operations.

The system architecture and concept needs to be developed in FAA by the broad gauge, high-level multi-disciplinary System Design Team urged by the FAA R&D Advisory Committee. The Working Group is prepared to support this effort from its perspective. RTCA might be in a unique position to help by examining the optimum balance of technical responsibility between the aircraft and the ground systems, and establishing the optimum technical interface standards.

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U.S. Department
of Transportation
Federal Aviation
Administration

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

May 14, 1991

The Honorable Tom Lewis
House of Representatives
Washington, D.C. 20515

Dear Mr. Lewis:

Thank you for your letter concerning the Federal Aviation Administration's (FAA) commitment to long-term fire and cabin safety-related research. At the outset, let me assure you that all of us in the FAA are distressed over the loss of life resulting from accidents that are aviation-related. Aviation safety is the FAA's primary mission, and I am personally committed to near- and long-term research to develop fire-resistant cabin interiors and other research to enhance post-crash survivability and lessen the serious consequences of an onboard fire.

Our commitment to research is reflected by regulatory initiatives and fire research accomplishments that we believe have significantly enhanced aircraft fire safety. For example, urethane foam has historically been a major contributor to fire-related fatalities in impact-survivable accidents. As a result of FAA-sponsored research, seat cushion fire blocking materials were developed and have been mandated since November 1987. Seat cushion fire blocking layers provide passengers with additional time to evacuate in a post-crash fire. The crash of a B-727 on take-off, at the Dallas/Fort Worth Airport in August 1988, demonstrated dramatically the effectiveness of our fire blocking requirement. Although the aircraft was completely destroyed by fire, 94 passengers and crewmembers out of a total of 108 survived. In the accident investigation report, the National Transportation Safety Board stated that passengers survived because the seat cushions were covered with fire blocking material.

Our cabin flammability regulations were implemented in two stages, August 1988 and August 1990. Each stage introduced successively more severe requirements for heat release, and the second stage also included a smoke emission standard. This standard mandated the usage of cabin materials that reduce the intensity of fires and the density of smoke by significant amounts.

As examples of the magnitude of change, the first stage required that materials have a peak heat release of not more than 100 kilowatts per square meter and a total heat release of not more than 100 kilowatt-minutes per square meter (100/100). The second stage reduced these values to 65/65 and introduced a smoke emissions requirement of a specific optical density of 200 (65/65/200). These regulations, which apply to aircraft sidewalls, ceiling, stowage bins, and partitions, provide passengers with more time to evacuate in a post-crash fire. Our standards were, indisputedly, a technology driver that advanced the state of the art for aircraft composites and thermoplastics in large surface areas; namely, interior applications. New material designs had to be developed for practically all applications impacted by the regulation.

Our most recent fire test standard became effective on March 20 of this year and is applicable to all airliners in service. The regulation requires burnthrough-resistant cargo liners to control and contain in-flight fires originating in cargo compartments, isolating the rest of the aircraft and its occupants from the fire. Like the standards for fire blocking seat cushions and cabin flammability materials, this regulation is a product of the FAA's fire research program.

As a result of the Aviation Safety Research Act of 1988, Public Law 100-591, much of our research program continues to make progress toward the goal of an all fire-resistant cabin interior. Examples include seven full-scale fire tests to study and understand how an external fuel fire burns through a fuselage shell and ignites cabin interior materials. In October 1990, we simulated many of the factors present in the August 1985 Manchester accident where an early burnthrough occurred. Early next year, we will begin to evaluate promising methods and materials to protect further the aluminum hull and cabin interior from burnthrough by an external fuel fire. We have also developed improved testing methodologies for aircraft wiring, related to flammability, smoke, and arc tracking. Our aircraft wiring project manager was deeply involved in the U.S. Air Force-sponsored program to develop the next generation of aircraft wiring insulation material. Finally, all FAA-required material fire test methods are now documented in an Aircraft Material Fire Test Handbook, which was published in December 1990. This handbook contains a detailed description of each fire test method, using a consistent format, and has improved the reproducibility of test results which had not been available in the past.

Parallel to our research and regulatory initiatives on fire-resistant materials, one of our highest priority projects has been to develop an onboard cabin water spray system. The system consists of an array of water spray nozzles along the ceiling of an aircraft. In the event of a post-crash fire, the system is designed to spray water throughout the cabin from a dedicated onboard water supply for a period of three minutes. Our full-scale test results, conducted on narrow (B-707) and widebody (DC-10) fuselages, indicate a two- to three-minute improvement in survival time for several fire scenarios. Only under a simulated high ambient wind test condition, which caused the fuel fire flames to travel across the cabin width, was the water spray ineffective.

This concept offers the greatest potential improvement in post-crash fire safety in the near term. However, before we can consider rulemaking, disadvantages of excessive weight and of accidental in-flight water discharge must be carefully evaluated.

Pursuant to the 1988 legislation we have also initiated research and made notable progress in the development of fire and smoke containment systems for in-flight fires. The Aircraft Command in Emergency Situations (ACES), a computerized fire detection system, differs from current fuselage fire detectors which provide an aural signal in the cabin or a visual indication in the cockpit. As a computerized system, ACES would add several detectors and process the analog signals with a cockpit computer to guide the crew to the source of the fire. We have completed a feasibility study and a systems design study. A prototype system is currently being produced. Tests will be conducted in a ground-based fuselage to demonstrate the advantages of the prototype ACES system. The ACES system is designed to assist the flightcrew to make the proper decisions more quickly when faced with a possible or actual in-flight fire.

In addition, we have made considerable progress with an in-flight smoke venting project, examining improved procedures and systems for evacuating smoke from an aircraft cabin during an in-flight fire. An important milestone was the signing of the FAA's first Cooperative Research and Development Agreement with Adams-Rite Corporation for the fabrication of hand-operated smoke evacuation valves. The valves were tested on the FAA's B-727 and were shown to be more effective than conventional emergency procedures when employed in a forward-scoop/aft-ejector mode with smoke originating in the aft cabin. In conjunction with our fire research efforts, personnel from the Technical Center in Atlantic City were recently awarded a patent for a buoyant artificial smoke generator. The generator employs helium to create buoyancy and to make a more realistic smoke simulant.

Finally, as part of our overall research to improve fire and smoke containment systems for in-flight fires, we have recently started testing fire detection, fire containment, and fire fighting tactics for "combi" aircraft where cargo compartments share the main deck with the passenger cabin. Because of the proximity of the cargo compartments and passenger cabins and the possibility that cargo fires may fester and burn unnoticed for long periods, they are particularly dangerous on "combi" aircraft.

Related to our in-flight fire safety research is the Halon replacement guidelines project. As you know, Halons are the agents of choice in aircraft powerplant, cargo compartment, and lavatory waste bin fire extinguishing systems and in portable fire extinguishers. However, Halons will be phased out of production by the end of this century, by international agreement, because of the destructive impact on the stratospheric ozone layer. Our proactive research and testing is directed at the development of equipment for recycling and recovering Halon 1301 and guidelines for the approval of replacement agents developed by industry.

We have made significant improvements in the fire resistance of cabin materials through our research and regulatory initiatives. Our mandated standards for low-heat and low-smoke release panels have clearly advanced the state of the art to or near its practical limit, at least for the near term. As one researcher stated in a recent article in the March 1991 issue of Aerospace America, "We're taxing the limits of organic chemistry...(with respect to the FAA test criteria)." While we are aggressively continuing our long-term research of fire-resistant cabin material applications, we believe that fire management systems, such as the water spray misting, offer the greatest promise of additional fire safety gains.

I am aware of your strong personal interest in aviation safety and long-term aviation related research. Much of what we have accomplished would not have been possible without your strong support and that of the Subcommittee on Technology and Competitiveness. Much more remains to be done, and I am committed to seeing that our overall research program continues to explore the most technologically advanced solutions.

Thank you for your interest in and continued support for aviation safety and aviation related research. Joseph Del Balso and I look forward to working closely with you and the Subcommittee to further enhance FAA's research and development program.

With respect to your request for our annual budget justifications, I apologize for any misunderstanding. I have directed our budget office to, henceforth, provide copies of the justifications to the Subcommittee on Technology and Competitiveness immediately after their delivery to the Appropriations Subcommittee on Transportation.

Sincerely,

J. B. Busey

James B. Busey
Administrator

U.S. Department
of Transportation
**Federal Aviation
Administration**

800 Independence Ave., S.W.
Washington, D.C. 20591

May 17, 1991

The Honorable Tim Valentine
Chairman, Subcommittee on Technology
and Competitiveness
Committee on Science, Space, and Technology
House of Representatives
Washington, D.C. 20515

Dear Chairman Valentine:

This is in response to your request at the May 16 hearing before the House Subcommittee on Competitiveness and Technology on the status of the Federal Aviation Administration (FAA) research to develop scientifically valid maximum allowable levels of alcohol, drugs, or other substances in the blood of pilots, controllers, and others in safety critical positions. As you correctly pointed out during the hearing, the direction to establish such a research program was contained in House Report 101-585, which accompanied H.R. 4949, the Federal Aviation Administration Research, Engineering, and Development Authorization Act of 1990.

The FAA has a long-standing and continuing interest in ensuring that the performance of operators, controllers, and other personnel within the National Airspace System is not impaired by drugs or alcohol. Regulatory initiatives have been used to restrict alcohol use and reduce the probability that safety personnel are active drug abusers. Research in this critical area is being conducted at the FAA's Civil Aeromedical Institute (CAMI) in Oklahoma City.

As you know, CAMI conducts research on the biomedical and psychological aspects of human performance, while research conducted at the Technical Center focuses on system technology and human engineering impacts. As you are well aware, CAMI has historically conducted active research to assist the National Transportation Safety Board in determining the role of medical factors in aviation-related accidents, including the presence of alcohol and drugs.
that research continues today.

CAMI, which is a major component of the FAA's Office of Aviation Medicine, has a long-standing interest and involvement in research to determine the maximum allowable levels of alcohol/drugs and the extent to which drugs, alcohol, or other substances may impact performance. Alcohol and drug research being conducted at CAMI is specifically devoted to the determination of the presence of alcohol or drugs in blood and tissue samples from personnel involved in aircraft accidents.

In the last two years, we have significantly enhanced our research capabilities in this area, with the adding of state-of-the-art equipment, the hiring of new personnel, and the development of internal and external quality control procedures for the analysis of samples.

CAMI has also been involved with laboratory studies evaluating both short- and long-term (hangover) effects of alcohol on performance. Current research includes an investigation of the effects of low levels of blood alcohol performance in the use of localizer and glide scope operations through the use of simulators. Other on-going research includes improvement of means to detect chemicals such as alcohol, therapeutic, and illegal drugs; development of an automated, cognitive function test that is sensitive to chronic drug abuse (and its associated cognitive decrement); refinement of an automated cognitive function test which is sensitive to chronic drug abuse; and performance impact of calcium channel blocker antihypertensives.

CAMI will continue research in the development and evaluation of technology, procedures, and techniques for assessing the possible impairment of personnel. I am advised by the Associate Administrator for Aviation Standards that the status of our alcohol and drug research will be provided in a report to Congress by September 30, 1992.

If I can be of further assistance, please let me know.

An identical letter has been sent to the Subcommittee's Ranking Member, Congressman Tom Lewis.

Sincerely,

Joseph M. Del Balzo

Joseph M. Del Balzo
Executive Director for
System Development

Summary of FAA Responses to Hearing Questions

1. Lewis letter to FAA Administrator - April 11, 1991

The Lewis letter to Busey requested answers to the following:

- FAA efforts to hire new fire research scientists since 1988
- Scientific publications in fire research since 1988
- Request for FAA budget justification books
- Request documentation on FAA actions and accomplishments to fulfill mandates of P.L. 100-591 regarding research to develop an all fire resistant cabin interior

2. Busey Response - May 14, 1991

- Seat cushion fire blocking mandated November 1987
- Cabin flammability regulations in 1988 & 1990
  Materials must have reduced heat release (1988)
  Materials further reduced in heat release and smoke emissions reduced (1990)
- March 20, 1991 rule requires burnthrough-resistant cargo liners in cargo compartments.

FAA's fire research supported the above regulations.

All fire-resistant cabin interior research;

- 7 full-scale fire tests on fuselage burn through
- 1992 will evaluate methods & materials to protect further burnthrough by external fuel fire
- Developed improved testing for aircraft wiring
- Published, Dec. 1990, Aircraft Material Fire Test Handbook
- Research to develop an onboard cabin water spray system
- Developing computerized fire detection system
- Developing in-flight smoke venting project
- Testing fire detection, containment and fighting tactics
- Studies to replace halons in fire extinguishers

A significant policy change was made in that the budget justification books will be delivered to the Subcommittee "immediately after their delivery to the Appropriations subcommittee...."

3. FAA response to May 16 hearing question on status of R&D in drug and alcohol testing mandated by P.L. 101-508.

Response by Joe DelBalzo, received May 17 (within 72 hours):

- Research to support regulatory initiatives to restrict alcohol use and reduce the probability that safety personnel are active drug abusers.
- Research to assist NTSB in determining the role of medical factors in aviation-related accidents, including the presence of alcohol and drugs.
- Research to determine the presence of alcohol or drugs in blood and tissue samples from personnel involved in aviation accidents.
- Studies evaluating both short- and long-term (hangover) effects of alcohol on performance.

4. FAA response to May 16 hearing question on hiring of research scientists since 1988.

Response by Joe DelBalzo, May 21 (within 72 hours):

19 PhD
27 MS
46 BS
5 AA or no college degree

(This is broken down into areas mandated by P.L. 100-591:
Aging Aircraft - 2 PhD; 1 MS
Human Factors - 4 PhD; 1 MS
Fire R&D - 1 PhD in Combustion toxicity
Maintenance R&D- 0

(Total FAA Personnel in Research, Engineering and Development:
From FAA Budget Books

1990 - 662
1991 - 669
1992 - 728 (request)

5. Questions submitted to FAA in writing May 17, 1991.

FAA responses, May 28, 1991:

I. FAA mandated to undertake or supervise research to
  A. "Assess the fire and smoke resistance of aircraft materials"
  B. "develop advanced aircraft fuels with low flammability and technologies for containment of aircraft fuels for the purpose of minimizing post-crash fire hazards."

Q. 1. Research scientists hired to implement A? B?

Answer:

None. "We do, however, have a complement of 30 technicians, chemists, and engineers...diligently working to develop a fire-resistant cabin interior."

Q. 2. Comparison of budgets 1988 vs 1992 for A & B.

Answer:

	A	B
1988	$125 thousand	$660 thousand
1992	$650 thousand	$1.225 million

Q. 3. Number of scientific articles in peer reviewed journals in A and B since 1988?

Answer:

None. But have prepared papers, presentations or reports in A = 9 and B = 7.

II. Reprogramming

Q. 1. GAO found in 1988 that FAA reprogrammed 70 of 99 subprograms. P.L. 101-508 mandates a report on the impact of reprogramming on long-term R&D.

Answer:

Appropriations Committees mandated a change in reprogramming in FY 1991. Funding shifts of 25% or $3 million (which ever is less) must be approved by Appropriations before reprogramming.

In FY 1991 (as of April 30, 1991), reprogramming totaled $4.5 million or 2.2 percent of the $205 million R&D appropriation. This is 79 percent below FY 1990 reprogramming. It involves 40 of 91 subprograms.

A report will be sent to the Subcommittee shortly after the close of FY 1991.

III. R&D Advisory Committee

Q. List members who are from Universities, Corporations, Associations, Consumers and Other government agencies?

Answer:

Academia - 2
Corporations - 7
Associations - 5
Other Government Agencies - 2

Consultants - 3

Q. Members who have had 'education, training, or experience" in scientific research in aviation safety?

Answer:

John McCarthy, Ph.D. National Center for Atmospheric R&D
Garrison Rapmund, M.D. Retired (Was Assistant Surgeon General of Army R&D)

Q. Do any of the members have any experience in conducting scientific research in fire safety?

Answer:

Dr. Garrison Rapmund, conducted medical R&D in fire retardant clothing for the military.

IV. Catastrophic Failure Prevention R&D

Question: What long-term R&D projects does FAA have to fulfill provisions of catastrophic failure R&D?

Answer:

o FAA R&D Advisory Committee's Subcommittee on Transport Airplane Safety Subcommittee is considering adequacy of R&D underway & that planned in aircraft survivability and airworthiness.

o Iowa State projects in technology applications, engineering research and education and training.

o FAA R&D underway in advanced lightweight materials for turbine rotor failure hazards protection, failure prediction diagnostics and advanced in situ rotor system inspection techniques.

o Plans include establishing Centers of Excellence as focal points for specific research and information dissemination to industry.

Q. When will FAA develop & submit a plan for catastrophic failure R&D?

Answer:

"..we anticipate preparation of a research program plan during the next fiscal year."

HA:

U.S. HOUSE OF REPRESENTATIVES

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

SUITE 2321 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, DC 20515
(202) 225-6371

November 28, 1990

A9011290 19

Mr. Joseph M. Del Balzo
Executive Director for System Development
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, D. C. 29591

Dear Mr. Del Balzo:

Attached are questions on the Fiscal Year 1992 R,E,&D Program Budget Request. I would very much appreciate your answers to them by March 1, 1991.

Sincerely,

Robert G. Torricelli

ROBERT G. TORRICELLI, Chairman
Subcommittee on Transportation,
Aviation and Materials

RGT:ATl

Enclosure

RECEIVED
Nov 29 2 30 PM '90

FAA Questions

1. Please tabulate the FY 1991 current budget for Research, Engineering, and Development; by program line item as of January 1991, showing and explaining any significant changes from the initial budget submission to Congress.

2. Please trace the development of the FY-1992 and out year ('93-'96) RE&D budget request. Specifically, please show the budget submissions (a) as prepared by FAA, (b) as initially amended by OST, (c) as submitted to OMB following FAA appeal to the OST amendments, (d) as initially amended by OMB, and (e) as submitted to Congress following FAA appeal of the OMB amendments. Please explain the changes that occurred in each step of the budget development process.

3. Please provide a five-year RE&D milestone schedule corresponding to the Congressional budget submission identified in 2(e) above. Identify assumptions.

4. Please provide a five-year F&E budget plan, in appropriately inflated dollars, and milestone schedule through FY-1996. Identify assumptions.

5. Please indicate the number of FAA Full Time Equivalent (FTE) positions covered by the RE&D budget request. What is the cost of salaries and related expenses?

6. For the projects listed below, please give the FY-1992 RE&D and/or F&E budget request. Also, show the combined budget if the project is conducted jointly with other agencies. In addition, please give the current estimates of project cost and date of completion for discrete projects (e.g. AERA III, ASTA, AAS, etc.). Cost and completion date estimates are not necessary for general research areas (e.g. aging aircraft, human factors, etc.)

ATMS/TMS
AERA I
AERA II
AERA III
TATCA
ASTA
Precision Runway Monitor
ADS
GPS
Satellites
Aging Aircraft
Aircraft Safety
Airport Security
Human Factors
AWOS

CWP
Aeronautical Date Link
TDWR
HOST
AAS
VSCS
Mgmt & Control
NADIN
MLS
Airborne Windshear
NEXRAD
TDWR
Mode S
LLWAS
AFSS

U.S. Department
of Transportation
Federal Aviation
Administration

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

MAY 22 1991

The Honorable Tim Valentine
Chairman, Subcommittee on Technology
and Competitiveness
Committee on Science, Space,
and Technology
House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

This is in response to a letter from former Chairman Torricelli requesting information pertaining to the fiscal year 1992 Research, Engineering and Development Program Budget.

The information requested is enclosed, and identical information is being provided to Ranking Minority Member Tom Lewis. If additional information is necessary, please contact us.

Sincerely,

JBBusey

James B. Busey
Administrator

Enclosure

U.S. Department of Transportation
Federal Aviation Administration

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

MAY 22 1991

The Honorable Tom Lewis
Ranking Minority Member
Subcommittee on Technology
and Competitiveness
Committee on Science, Space,
and Technology
House of Representatives
Washington, DC 20515

Dear Mr. Lewis:

The enclosed information was sent to Chairman Valentine in response to a letter from former Chairman Torricelli requesting information pertaining to the fiscal year 1992 Research, Engineering and Development Program Budget.

If additional information is necessary, please contact us.

Sincerely,

J B Busey

James B. Busey
Administrator

Enclosure

Question 1: Please tabulate the FY 1991 current budget for Research, Engineering, and Development; by program line item as of January 1991, showing and explaining any significant changes from the initial budget submission to Congress.

Answer:

(SEE ATTACHED CHART)

Tabulation of the FY 1991 ($000)

R,E&D Budget Activity	FY 1991 Cong. Subm.	Cong. Add-on	FY 1991 Approp.	Adj.	FY 1991 Fiscal Program
1. Air Traffic Control					
a. System	14,899		14,899	-2,000	12,899
(1) Future System Definition	1,046				1,046
(2) Management & Control Process	3,136			-2,000 1/	1,136
(3) R,E&D Plan	584				584
(4) Separation Standards	3,868				3,868
(5) System Requirements	694				694
(6) System Engineering Mgmt.	428				428
(7) Synthetic Vision	1,082				1,082
(8) National Simulation Laboratory	4,082				4,082
b. Beacon	1,380		1,380		1,380
(1) Low-Altitude Communciations and Surveillance	250				250
(2) Mode S Integrated Tracker	1,130				1,130
c. Aircraft Separation Assurance	10,576		10,576		10,576
(1) TCAS I Implementation	584				584
TCAS II Computer Evaluation	491				491
TCAS III Development	2,331				2,331
TCAS II Implementation	3,234				3,234
TCAS III Implementation	3,936				3,936
d. Communications	11,084		11,084	-4,000	7,084
(1) Communication Planning & Design	766				766
(2) VSCS Prime Mission System	1,063				1,063
(3) NADIN II	230				230
(4) Aeronautical Data Link	9,025			-4,000 2/	5,025
e. System Capacity and Airports	33,773		33,773	+6,000	39,773
(1) Airport Pavement	1,905				1,905
(2) Reduced Runway Occupancy Time	1,545				1,545
(3) Airport Safety Planning	808				808
(4) Airport Surface Visual Control (Lighting)	1,595				1,595
(5) Airport Safety Support System	868				868
(6) Terminal/Landside Traffic Modeling	575				575
(7) Capacity Development	2,831				2,831
(8) Airport Capacity Enhancement Planning	1,138				1,138
(9) Simulation Model Development and Validation	1,365				1,365
(10) Precision Runway Monitor - High Data Rate	2,000				2,000
(11) Wake Vortex Avoidance/ Advisory System	1,876				1,876
(12) Airport Surface Traffic Automation/AMASS	4,082			+6,000 2/	10,082
(13) Terminal Air Traffic Control Automation	7,582				7,582
(14) Airport Capacity Task Force Studies	2,151				2,151
(15) National Airspace System Performance Analysis Capability (NASPAC)	2,516				2,516
(16) Airspace System Models	946				946

($000)

R,E&D Budget Activity	FY 1991 Cong. Subm.	Cong. Add-on	FY 1991 Approp.	Adj.		FY 1991 Fiscal Program
f. Technology	8,362	3,100	11,462	-3,000		8,462
(1) Satellite Applications	3,164	3,100		-3,000	1/	3,264
(2) ATC Applications of Automatic Dependent Surveillance (ADS)	5,198					5,198
g. Support	7,827		7,827			7,827
(1) FAA/NASA Cooperative Programs	1,057					1,057
(2) Joint University Program	310					310
(3) Program Support	2,864					2,864
(4) R,E&D Advisory Committee	160					160
(5) Small Business Innovation Research (SBIR) Program	1,000					1,000
(6) Transportation Research Board (TRB)	200					200
(7) Technology Transfer	980					980
(8) Graduate-Level Research and Education in Aviation Technology (GREAT)	1,256					1,256
h. Rotorcraft and Power Lift Vehicles	4,018		4,018			4,018
(1) Rotorcraft/Power Lift Vehicles IFR Operations Evaluation	1,091					1,091
(2) Rotorcraft/Power Lift Vehicles Obstruction Avoidance	311					311
(3) Rotorcraft/Power Lift Vehicles ATC Procedures	116					116
(4) Rotrocraft Separation Standards	256					255
(5) Rotorcraft Simulator Standards	157					157
(6) Rotorcraft/Power Lift Vehicles Display, Control Studies and Certification Support	1,047					1,047
(7) Heliport/Vertiport Design and Planning	1,041					1,041
i. Human Systems and Operations	10,731		10,731			10,731
(1) Information Transfer & Management	982					982
(2) Causal Factors in Accidents and Incidents	1,082					1,082
(3) Human Factors Applications Support	582					582
(4) Control and Display Technology	882					882
(5) Flight Crew Certification & Training	2,522					2,522
(6) Aircraft Automation	1,082					1,082
(7) Human Performance Assessment and Improvement	982					982
(8) Flight Deck Certification Criteria	482					482
(9) Controller Human Factors	1,471					1,471
(10) Expert Systems Application to ATC	684					684
j. Flight Planning Optimization	1,096		1,096			1,096
(1) Dynamic Ocean Track System (DOTS)	846					846
(2) Jet Route & Terminal Area Optimization	250					250
TOTAL, AIR TRAFFIC CONTROL	102,746	3,100	105,846	-3,000		102,846

($000)

R,E&D Budget Activity	FY 1991 Cong. Subm.	Cong. Add-on	FY 1991 Approp.	Adj.	FY 1991 Fiscal Program
2. Advanced Computer					
a. Advanced Automation					
(1) Advanced Automation System Program Management	4,963				4,963
ATC Automation Bridge Development				+6,000 1/	6,000
b. ATC Automation					
(1) Advanced Traffic Management System	5,065			- 800 1/	4,265
(2) Automated En Route Air Traffic Control (AERA 3)	8,582			-2,000 2/	6,582
(3) Dynamic Special-Use Airspace Management	531			- 200 1/	331
TOTAL, ADVANCED COMPUTER	19,141		19,141	+3,000	22,141
3. Navigation					
(1) GPS Utilization	1,581				1,581
(2) Navigation Systems Development	882				882
(3) Navigation Systems Engineering	896				896
TOTAL, NAVIGATION	3,359		3,359		3,359
4. Aviation Weather					
a. Aviation Weather					
(1) Central Weather Processor (CWP)	1,653				1,653
(2) Icing Forecasting Improvements	982				982
(3) Airborne Windshear Detection and Avoidance	1,041				1,041
(4) Expanded Low-Level Windshear Alert System (LLWAS)	500				500
(5) Windshear Terminal Information System Integration	841				841
(6) Terminal Weather Radar	2,022				2,022
(7) Airborne Windshear Advanced Technology	900				900
TOTAL, AVIATION WEATHER	7,739		7,739		7,739
5. Aviation Medicine					
a. Aviation Medicine					
(1) Aeromedical Program Support	656				656
(2) Protection & Survival	2,093				2,093
(3) Work Force Optimization Research	2,114				2,114
(4) Human Performance Research	714				714
(5) Aging Aircraft - Human Factors	896				896
TOTAL, AVIATION MEDICINE	6,473		6,473		6,473

($000)

R,E&D Budget Activity	FY 1991 Cong. Subm.	Cong. Add-on	FY 1991 Approp.	Adj.	FY 1991 Fiscal Program
6. Aircraft Safety					
a. Aircraft Safety					
(1) Aircraft Systems Fire Safety	5,001				5,001
(2) Propulsion and Fuel Systems	2,386				2,386
(3) Structural Crashworthiness/ Airworthiness	3,756	900	4,656		4,656
(4) Aging Aircraft	5,749	6,700	12,449		12,449
(5) Flight Safety/Atmospheric Hazards	3,888	300	4,188		4,188
(6) Explosives Detection	22,615	4,000	26,615		26,615
(7) Weapons Detection	1,899				1,899
(8) Airport Security	1,249				1,249
(9) Security Systems Integration	599				599
TOTAL, AIRCRAFT SAFETY	47,142	11,900	59,042		59,042
7. Environment					
a. Environment					
(1) Aircraft Engine Emissions	350				350
(2) Aircraft Noise Reduction & Control	2,050				2,050
TOTAL, ENVIRONMENT	2,400		2,400		2,400
TOTAL, R,E&D REQUEST	180,000	16,000	196,000	[illegible]	[illegible]

Congress added $4,600 in Air Traffic Control of which $1,500 is for Wichita State (shown in Aircraft Safety and Security in the Appropriation) and $3,100 is for satellites. The additional $10,400 for Aircraft Safety and Security is broken down as follows: $3 million – Centers for Aviation Systems Reliability; $3.4 million – Nondestructive Evaluation Center; and $4 million – Vapor Detection Research.

1/ FAA has made an adjustment in the Fiscal Program of $5 million from the Air Traffic Control activity to the Advanced Computer activity to fund the $6 million ATC Automation Bridge Development effort.

2/ FAA has requested reprogramming of $6 million in support of the ASTA/AMASS program in FY 1991. Source of funds: AERA–3 ($2 million) and Aeronautical Data Link program ($4 million).

Question 2: Please trace the development of the FY-1992 and out year ('93-'96) RE&D budget request. Specifically, please show the budget submissions (a) as prepared by FAA, (b) as initially amended by OST, (c) as submitted to OMB following FAA appeal to the OST amendments, (d) as initially amended by OMB, and (e) as submitted to Congress following FAA appeal of the OMB amendments. Please explain the changes that occurred in each step of the budget development process.

Answer:

(SEE ATTACHED CHART)

Development of the FY-1992 and Out Year ('93-'96) R,E&D Budget Request.

(funds in millions)

R,E&D Budget	FY-1992	FY-1993	FY-1994	FY-1995	FY-1996	FY-1997
(a) Requested by FAA:	230.0	300.0	300.0	300.0	305.0	
Air Traffic Control	113.6	159.5	166.2	165.7	165.3	
Advanced Automation	20.2	23.0	23.7	24.2	24.3	
Navigation	1.2	6.7	7.2	8.3	8.8	
Aviation Weather	7.6	10.2	10.3	10.3	10.4	
Aviation Medicine	13.2	17.0	17.3	17.6	17.9	
Aircraft Safety Tech	70.2	79.5	71.3	69.9	74.3	
Environment	4.0	4.0	4.0	4.0	4.0	
(b) Amended by OST:	220.0	300.0	300.0	300.0	300.0	
Air Traffic Control	105.1	159.5	166.2	165.7	165.3	
Advanced Automation	20.2	23.0	23.7	24.2	24.3	
Navigation	1.2	6.7	7.2	8.3	8.8	
Aviation Weather	7.6	10.2	10.3	10.3	10.4	
Aviation Medicine	13.1	17.0	17.3	17.6	17.9	
Aircraft Safety Tech	68.8	79.5	71.3	69.9	69.3	
Environment	4.0	4.0	4.0	4.0	4.0	
(c) Submitted to OMB:	220.0	300.0	300.0	300.0	300.0	
Air Traffic Control	105.1	159.5	166.2	165.7	165.3	
Advanced Automation	20.2	23.0	23.7	24.2	24.3	
Navigation	1.2	6.7	7.2	8.3	8.8	
Aviation Weather	7.6	10.2	10.3	10.3	10.4	
Aviation Medicine	13.1	17.0	17.3	17.6	17.9	
Aircraft Safety Tech	68.8	79.5	71.3	69.9	69.3	
Environment	4.0	4.0	4.0	4.0	4.0	
(d) Amended by OMB:	204.0	205.0	205.0	205.0	205.0	
Air Traffic Control	98.0	(OUTYEAR BUDGET NOT DEVELOPED AT THE 205M LEVEL)				
Advanced Automation	18.0					
Navigation	1.0					
Aviation Weather	4.0					
Aviation Medicine	11.0					
Aircraft Safety Tech	68.0					
Environment	4.0					
(d1) Appealed to OMB:	220.0	240.0	265.0	285.0	300.0	
		(OUTYEAR BUDGET NOT DEVELOPED AT THESE LEVELS)				

Development of the FY-1992 and Out Year ('93-'96) R,E&D Budget Request.

(funds in millions)

R,E&D Budget	FY-1992	FY-1993	FY-1994	FY-1995	FY-1996	FY-1997
(e) Submitted to Congress:	210.0	210.0	210.0	210.0	210.0	
Air Traffic Control	95.0	97.0	98.0	99.0	99.8	
Advanced Automation	25.2	19.1	18.4	17.7	17.1	
Navigation	1.2	1.2	1.3	1.3	1.3	
Aviation Weather	5.2	6.8	6.3	5.8	5.3	
Aviation Medicine	11.1	12.7	12.6	12.4	12.3	
Aircraft Safety Tech	68.3	69.1	69.5	69.8	70.1	
Environment	4.0	4.0	4.0	4.0	4.0	
(f) Proposed FY93 & Outyear budget by Thrust Activity:		270.0	320.0	370.0	420.0	493.0
Management		2.7	4.1	5.2	7.2	12.6
Capacity & ATC Technology		69.5	84.5	99.0	111.9	133.8
Com, Nav & Surveillance		23.0	31.7	41.7	46.3	51.5
Weather		5.3	6.1	7.0	8.8	9.2
Airport Technology		7.8	9.9	12.1	19.0	24.6
Aircraft Safety Tech		26.7	30.7	39.8	48.5	67.5
Sys Security Tech		38.1	45.2	47.2	49.7	49.5
Human Fact/Aviation Med		21.1	24.8	28.1	31.3	39.2
Environment/Energy		4.5	5.8	6.5	7.0	9.0
Innovative/Coop Research		5.6	8.8	11.4	14.1	16.7
* Inhouse/Infrastructure		65.7	68.4	72.0	76.1	79.4

Explanation of changes:

(b) The OST recommended a reduction from $230 million to $220 million. Reason: The FAA FY 1992 request was an increase of $35 million over our (OST) authorized proposal, an increase of $40 million (21 percent) over the FY91 budget request and $35 million (18 percent) over the House Appropriation Subcommittee mark for FY91.

(c) The budget was submitted to OMB on Sept. 15, 1990 at $220 million for FY92, $300 million for the outyears. The appeal to OMB (after the passback of Dec. 18 which straightlined us to the $205 million level) was for $240 million to $300 million in the outyears, FY94 through FY96 (d1).

(d) The OMB allowance level for the passback for R,E&D was $205 million. OMB stated this level was sufficient to fund R,E&D efforts in areas such as aviation security, the Advanced Traffic Management System and using satellites in aviation. The $205 million level included the requested FTE's and positions. OMB restored $5 million of the $15 million appealed and straightlined the outyears at the $210 million level.

(f) The proposed budget structure for FY93 and outyears will be by Thrust activity in order to correlate with the FY91 RE&D Plan Chapters. The outyears (FY93-FY97) will be requested at the $270 million, to approximately $500 million level. There are significant increases in major program areas of: Aircraft Safety & Security, Human Factors, Satellites, ATMS, Data Link, TATCA, ASTA, and the National Simulation Lab. *Inhouse/Infrastructure is not an activity, the funds will be spread throughout the thrust activities. Note: Question #4 referring to "Milestone & Schedules" is based on the 1993-1997 levels.

Question 3: Please provide a five-year RE&D milestone schedule corresponding to the Congressional budget submission identified in 2(e) above. Identify assumptions.

Answer:

(SEE ATTACHED SCHEDULES)

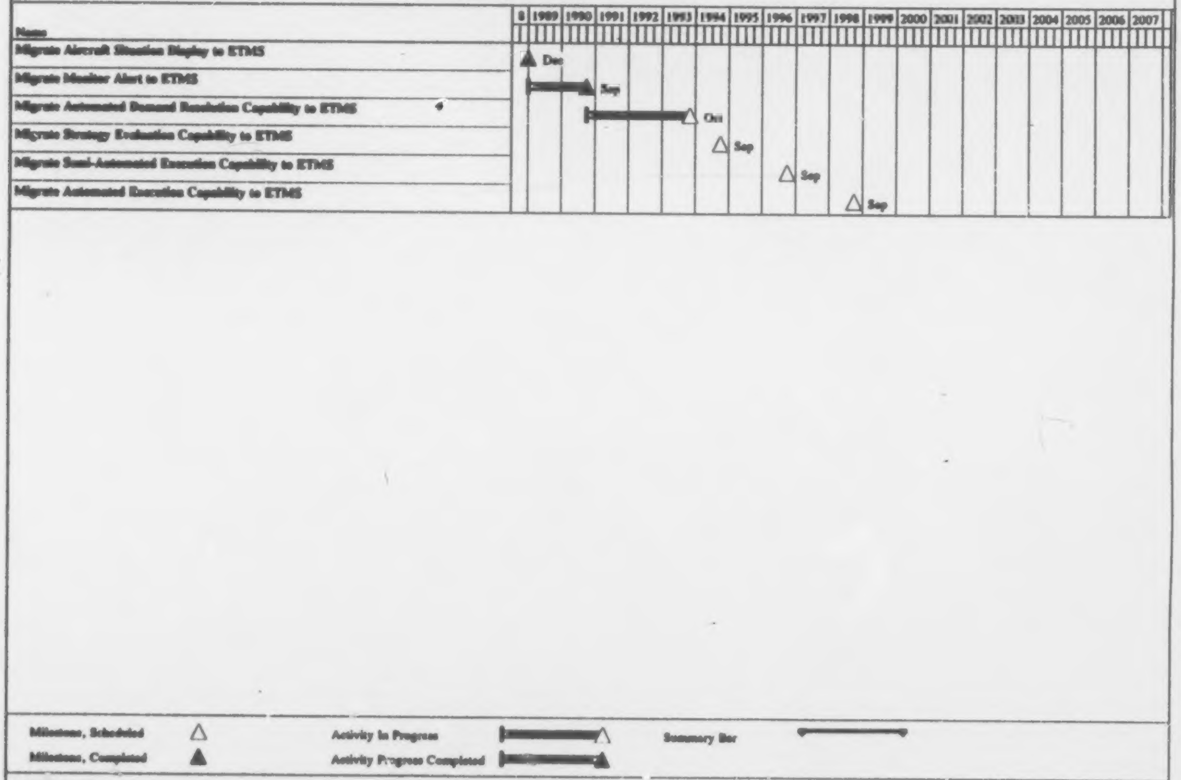
Assumptions:

- o Schedules and milestones are based on authorizations and appropriations which support an RE&D budget at the following levels as approved by FAA, OST, OMB and Congress per fiscal year:

-	FY 1993	$270M
-	FY 1994	320
-	FY 1995	370
-	FY 1996	420
-	FY 1997	490

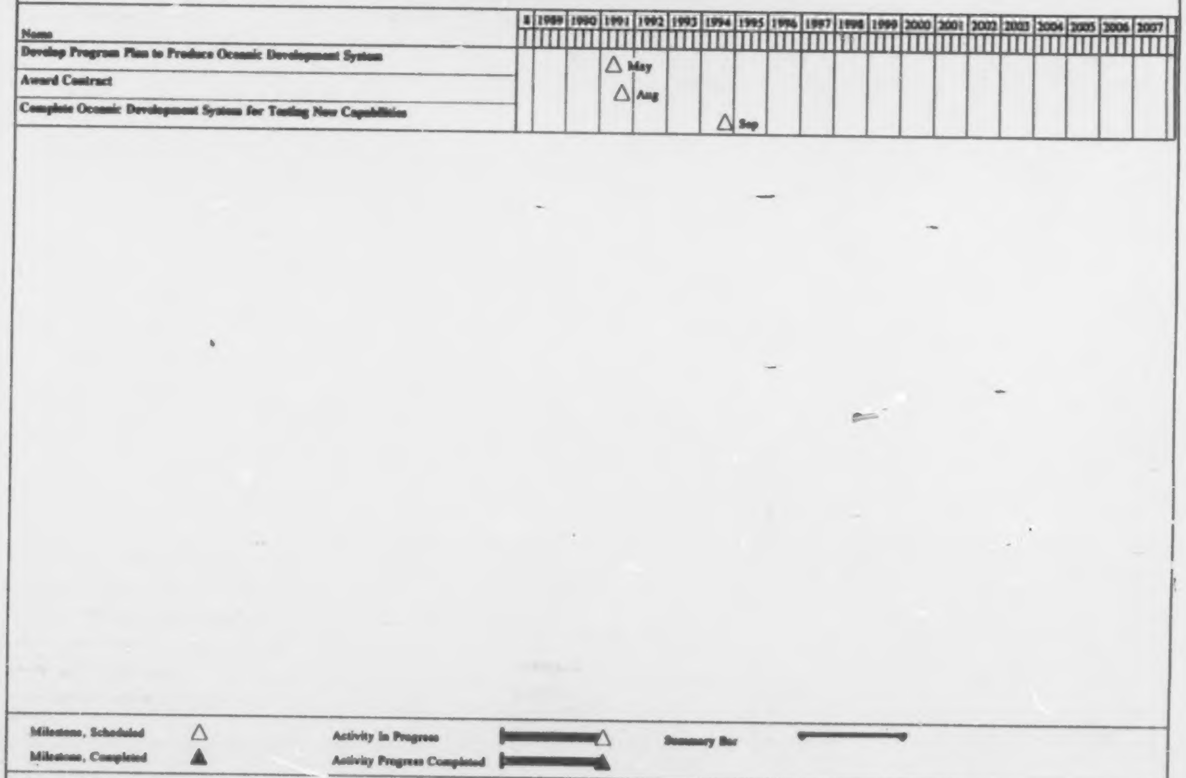
- o Schedules will slip and milestones will not be met consistent with reductions in approved funding levels for each increment of the 5-yr period and in total.
- o Funding reductions from the proposed may also defer some of these programs.
- o Schedules cover 20 years because the R,E&D Plan establishes the basis of planning for the future NAS.
- o Schedules are based on on-going R,E&D Plan development activities and will be changed as the Plan becomes finalized.

Advanced Traffic Management System (ATMS)



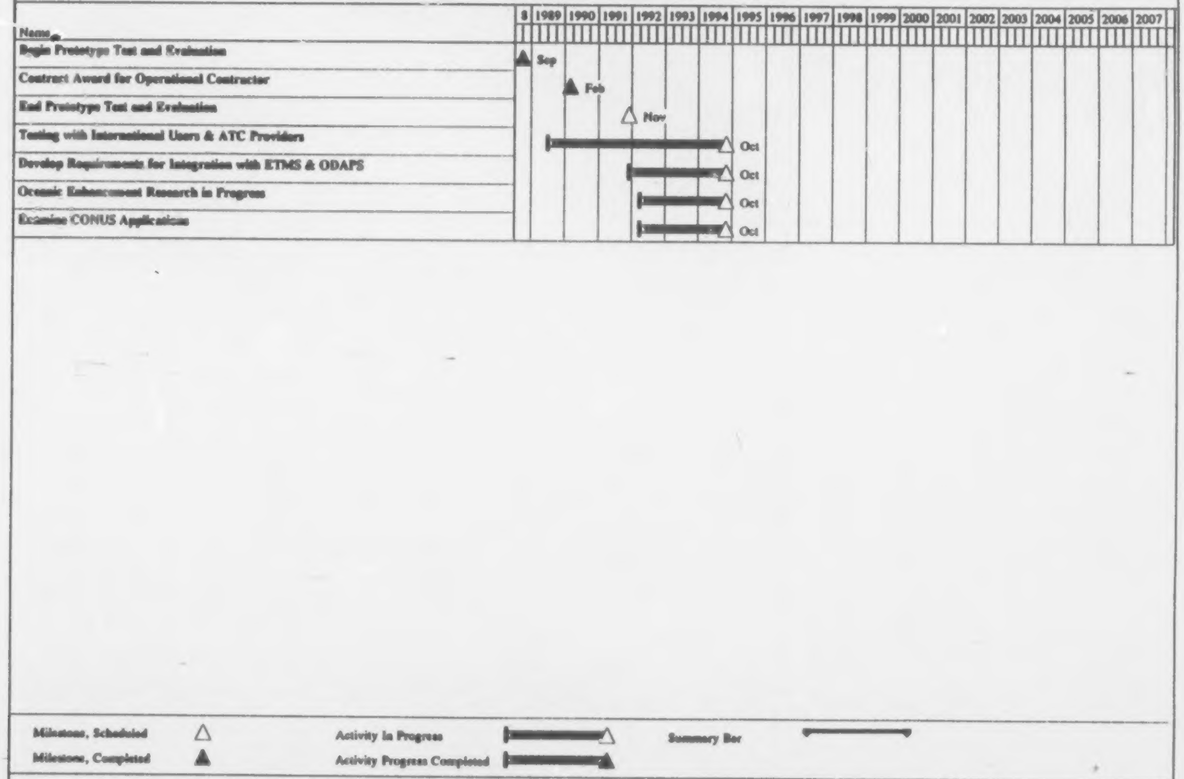
* Estimated Dates.

Oceanic ATC Automation



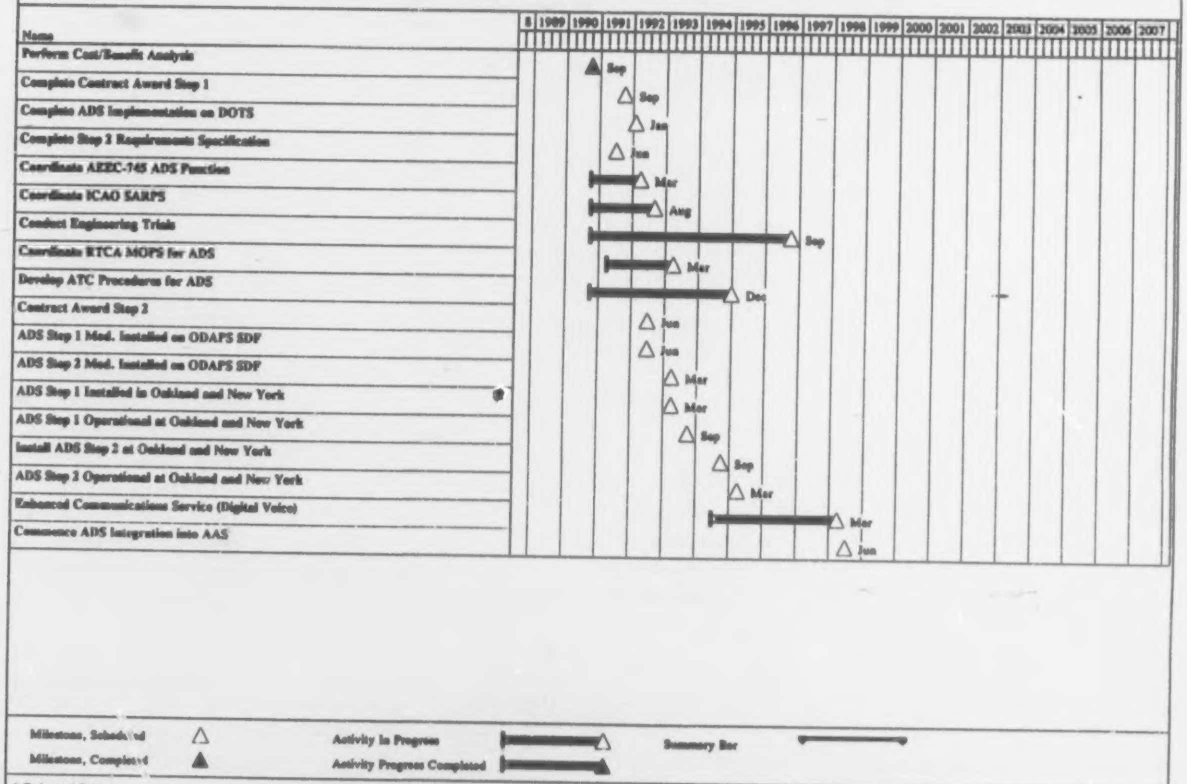
* Estimated Dates.

Airspace and Traffic Optimization (DOTS)



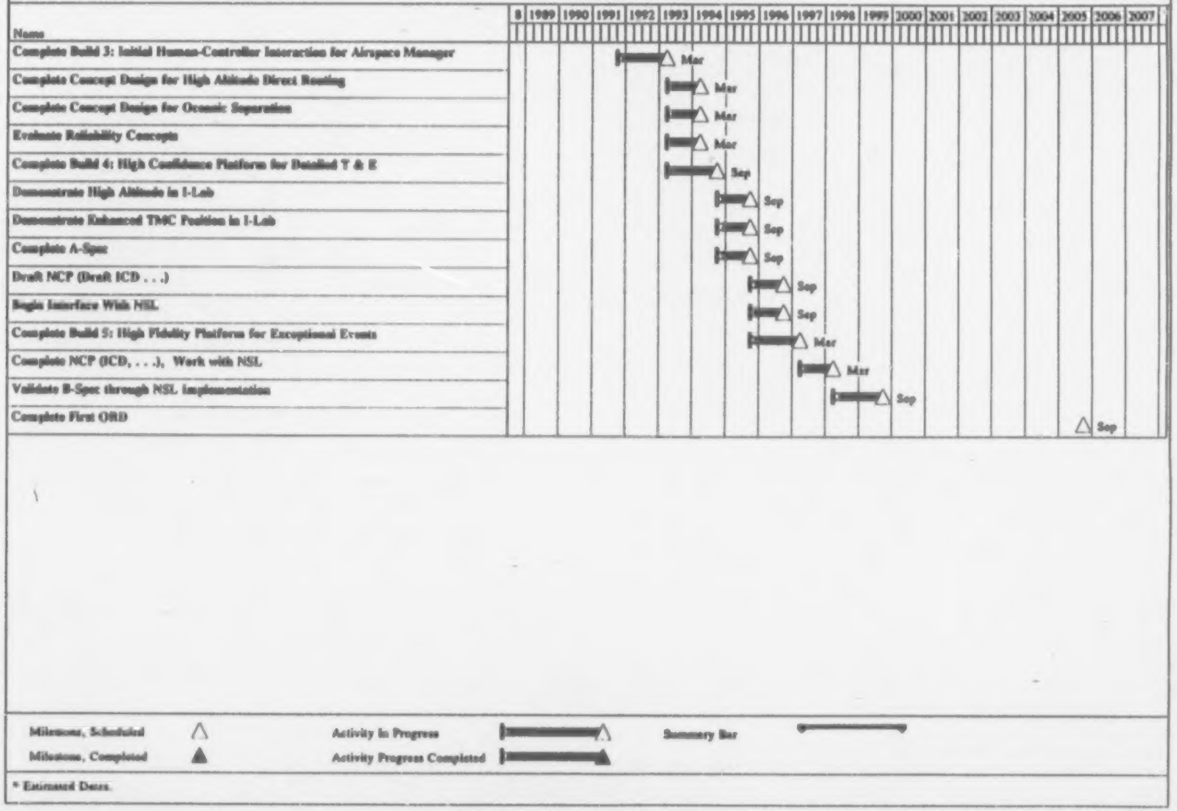
* Estimated Dates.

ATC Appl. of Automatic Dep. Surveillance (ADS)

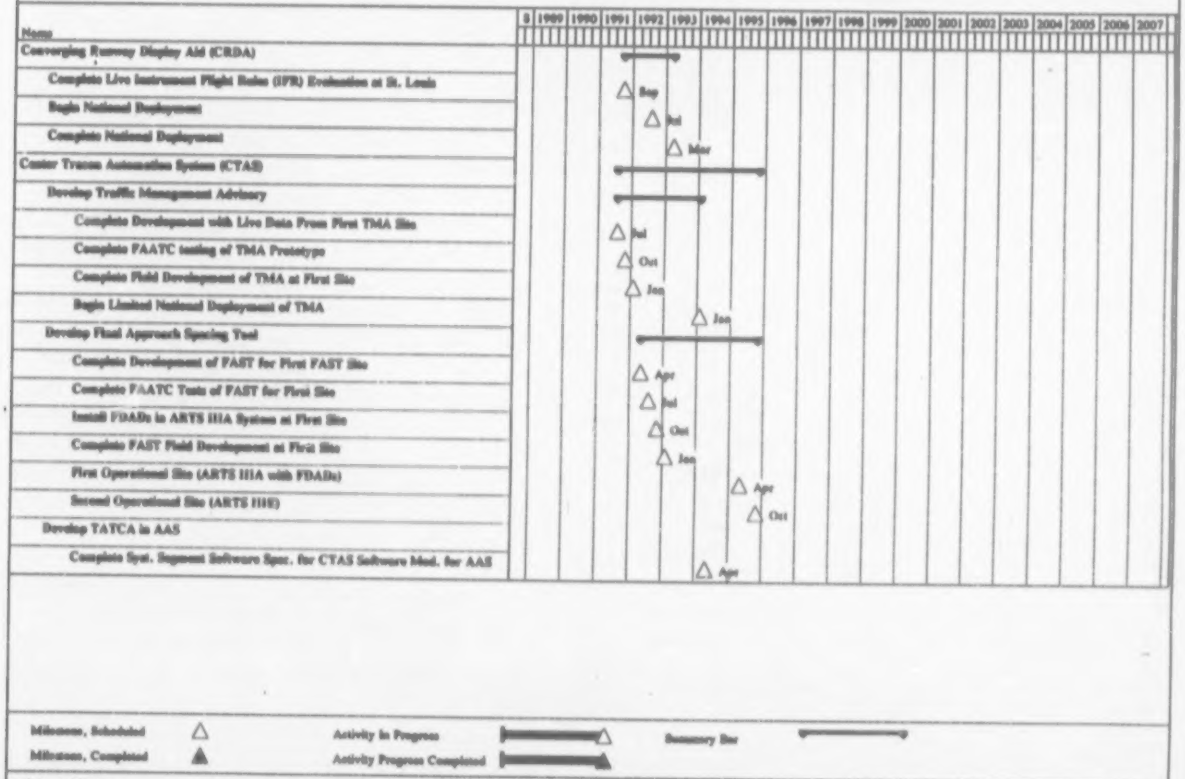


* Estimated Dates.

Advanced AERA Concepts

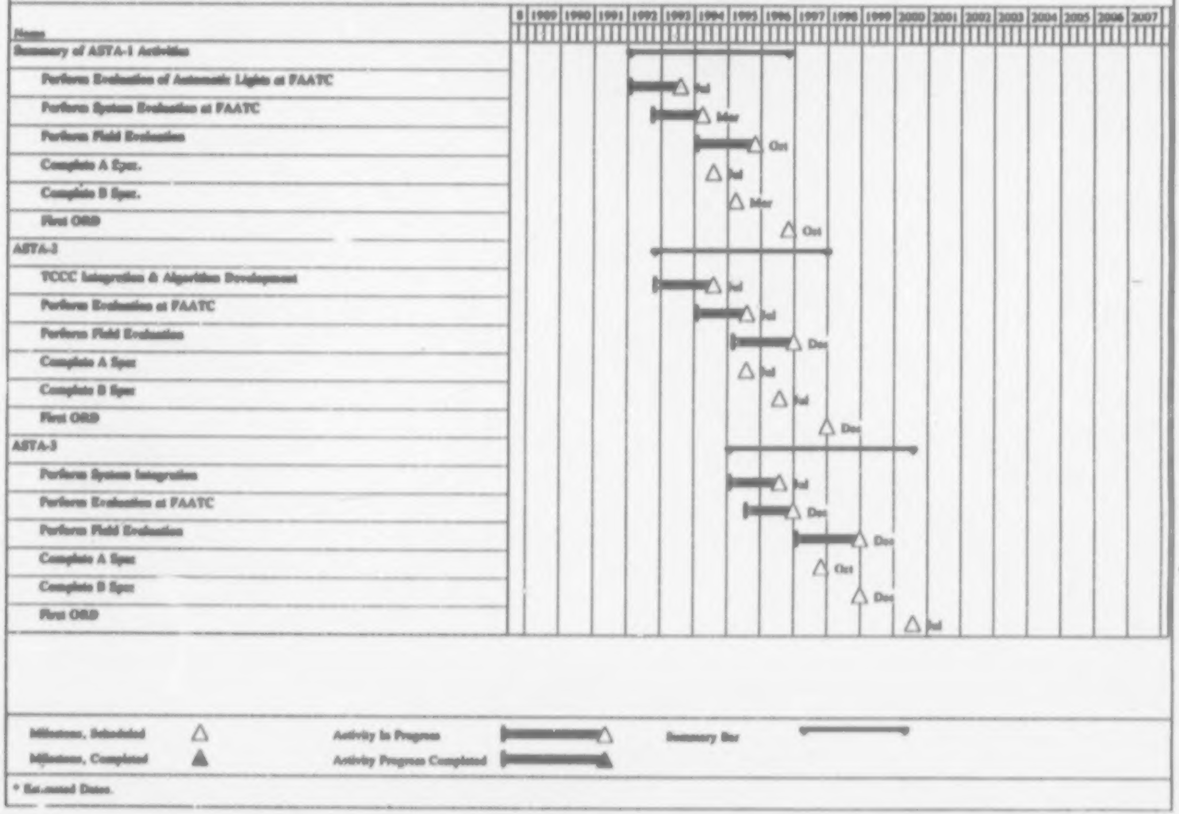


Terminal Air Traffic Control Automation (TATCA)

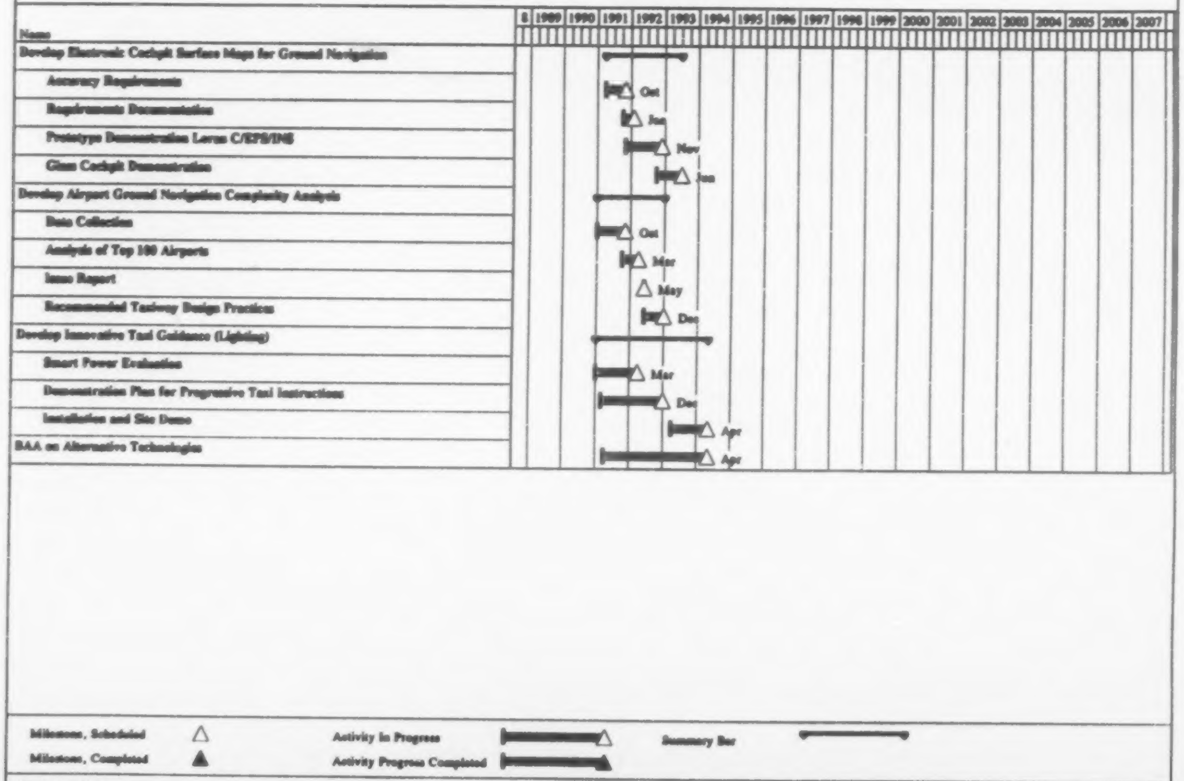


* Estimated Dates.

Airport Surface Traffic Automation (ASTA)

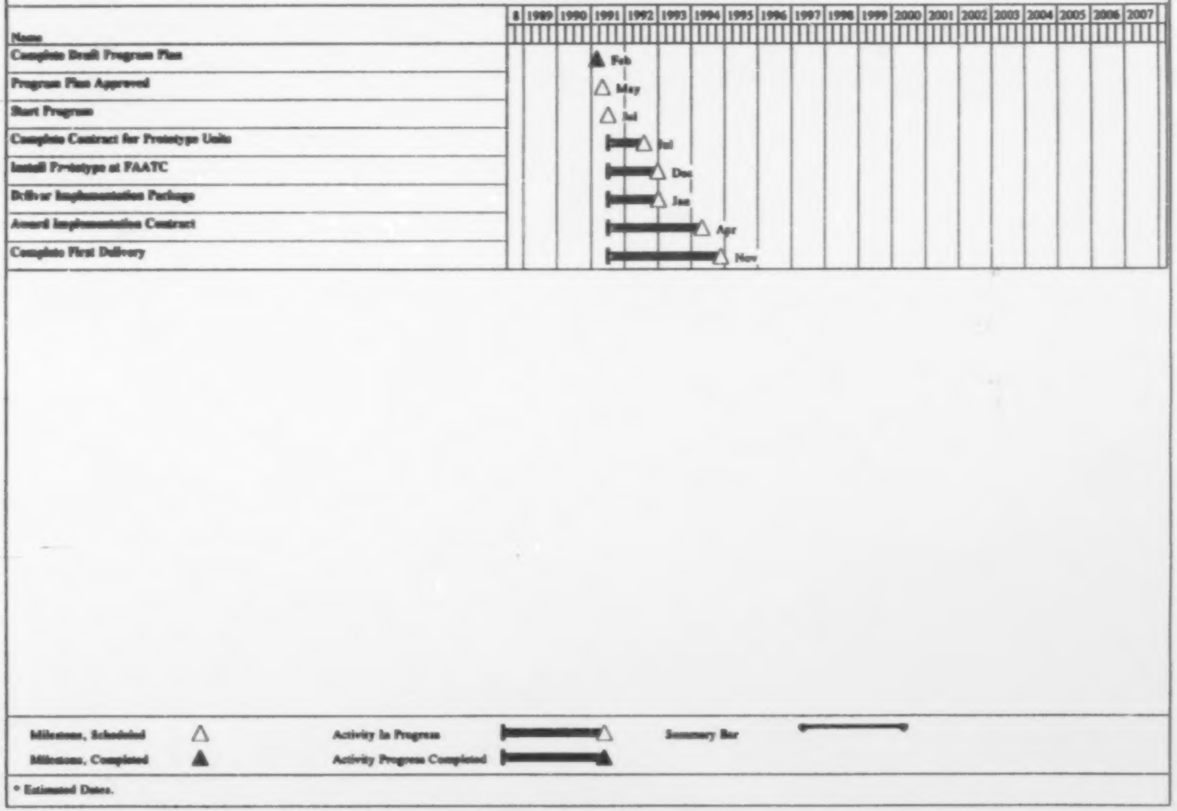


Surface Movement Safety & Guidance



* Estimated Dates

Consolidated Cab Display System (CCDS)



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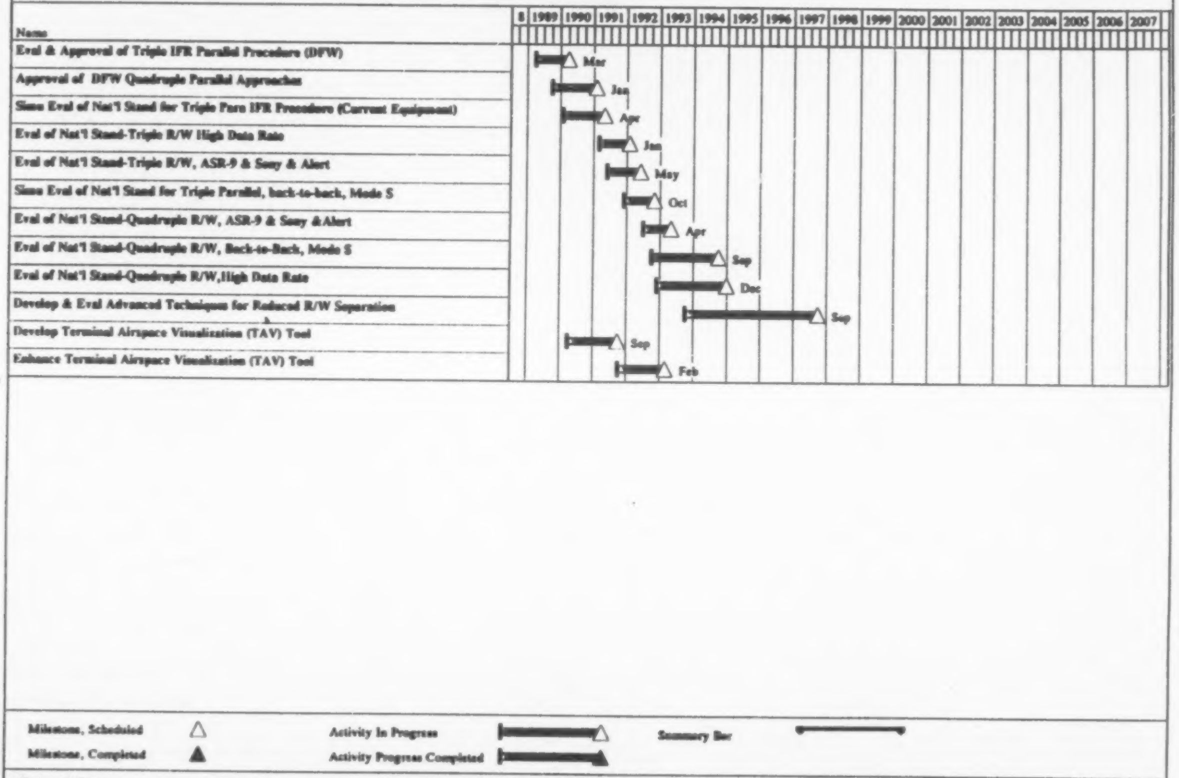
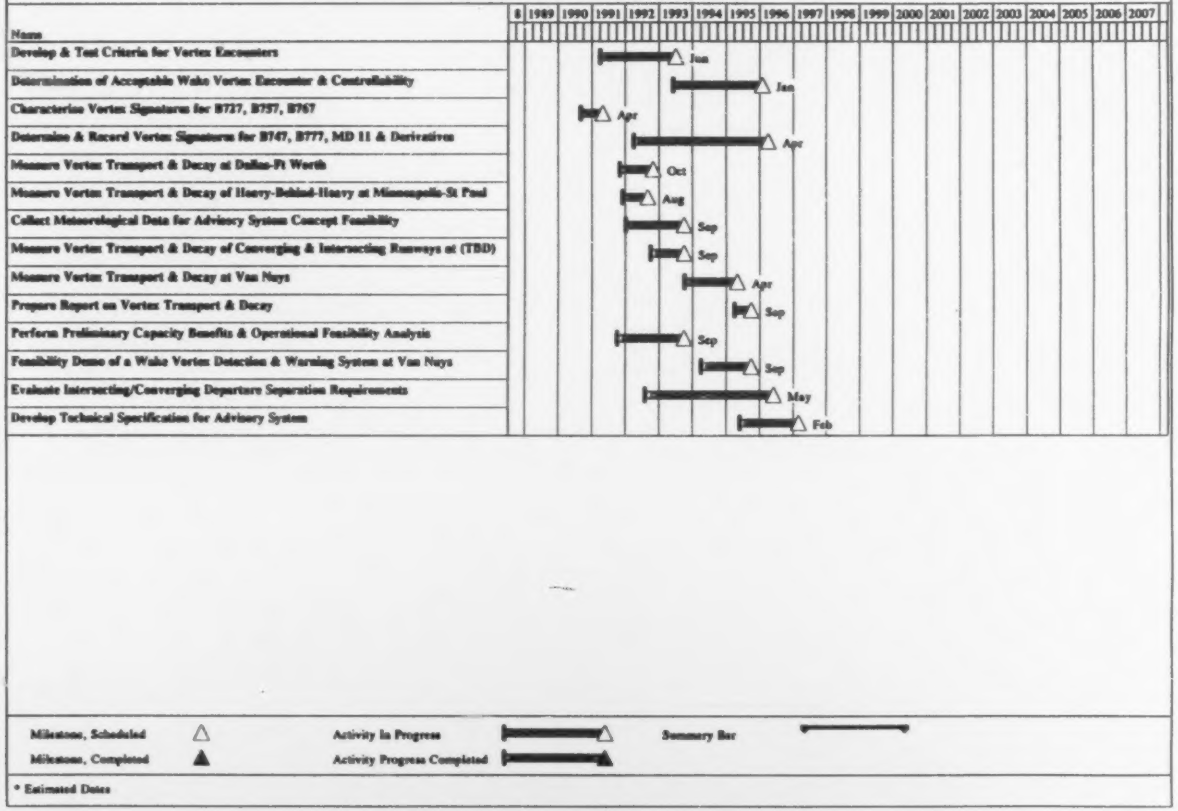
Airport Capacity Improvements

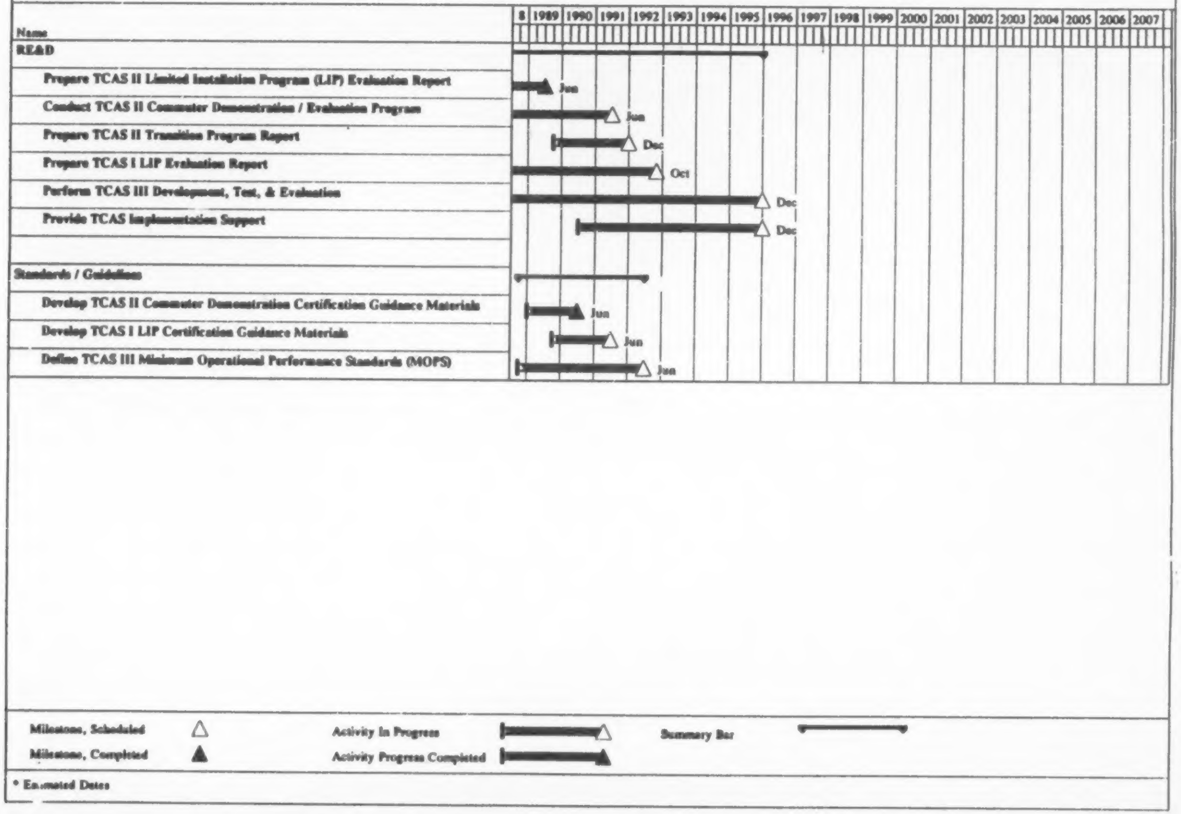


* Estimated Dates

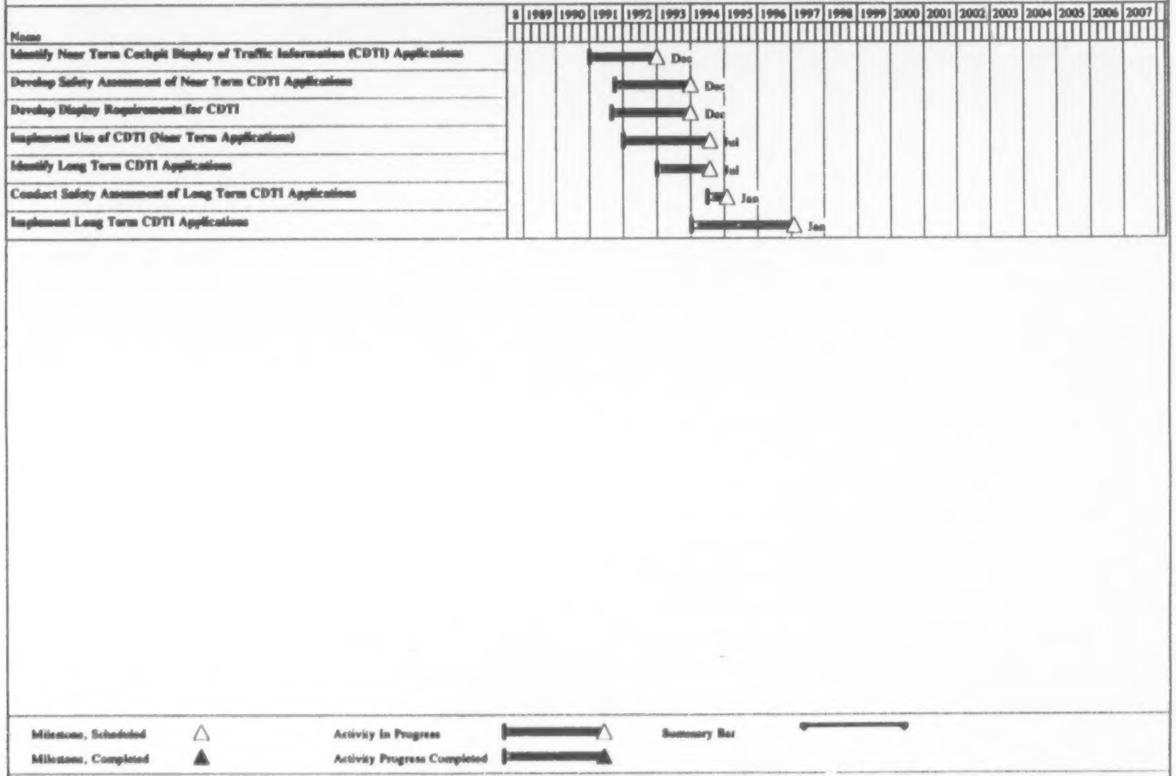
Wake Vortex Avoidance / Advisory System



Traffic Alert & Collision Avoidance System (TCAS)

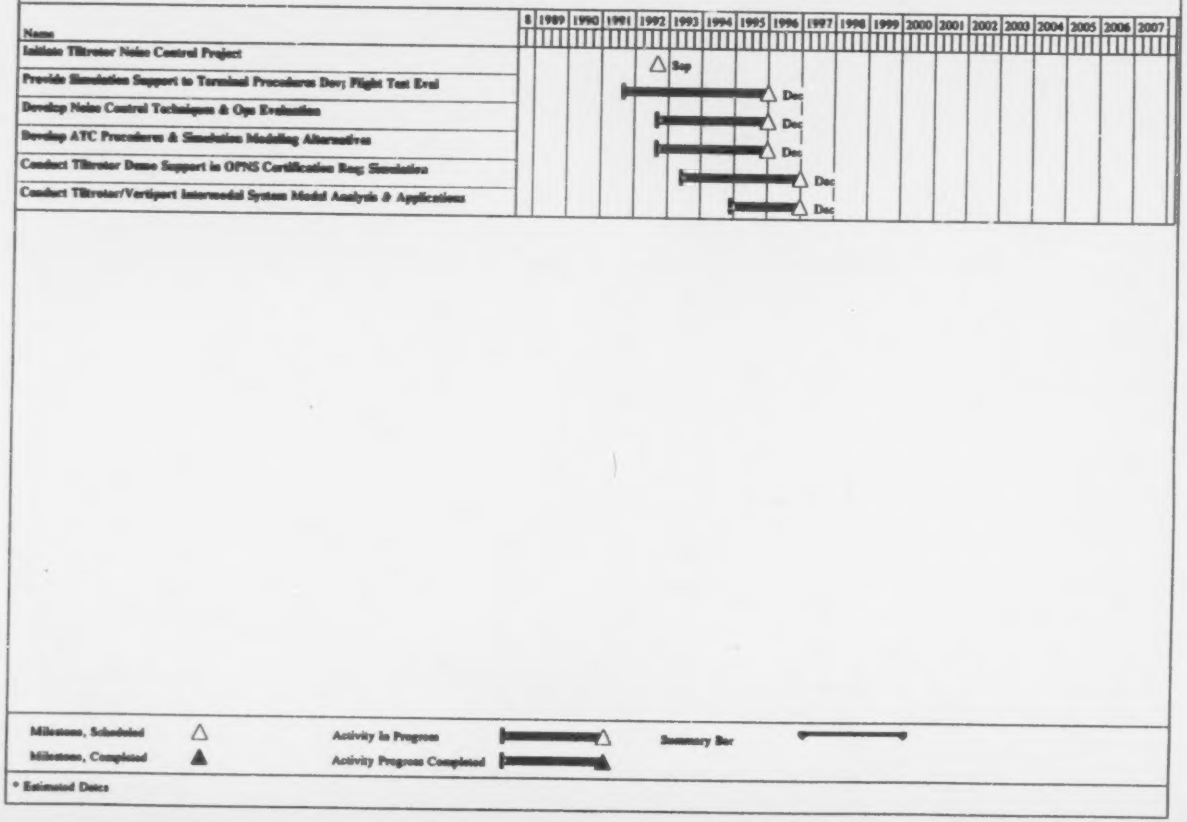


TCAS Cockpit Display of Traffic Information

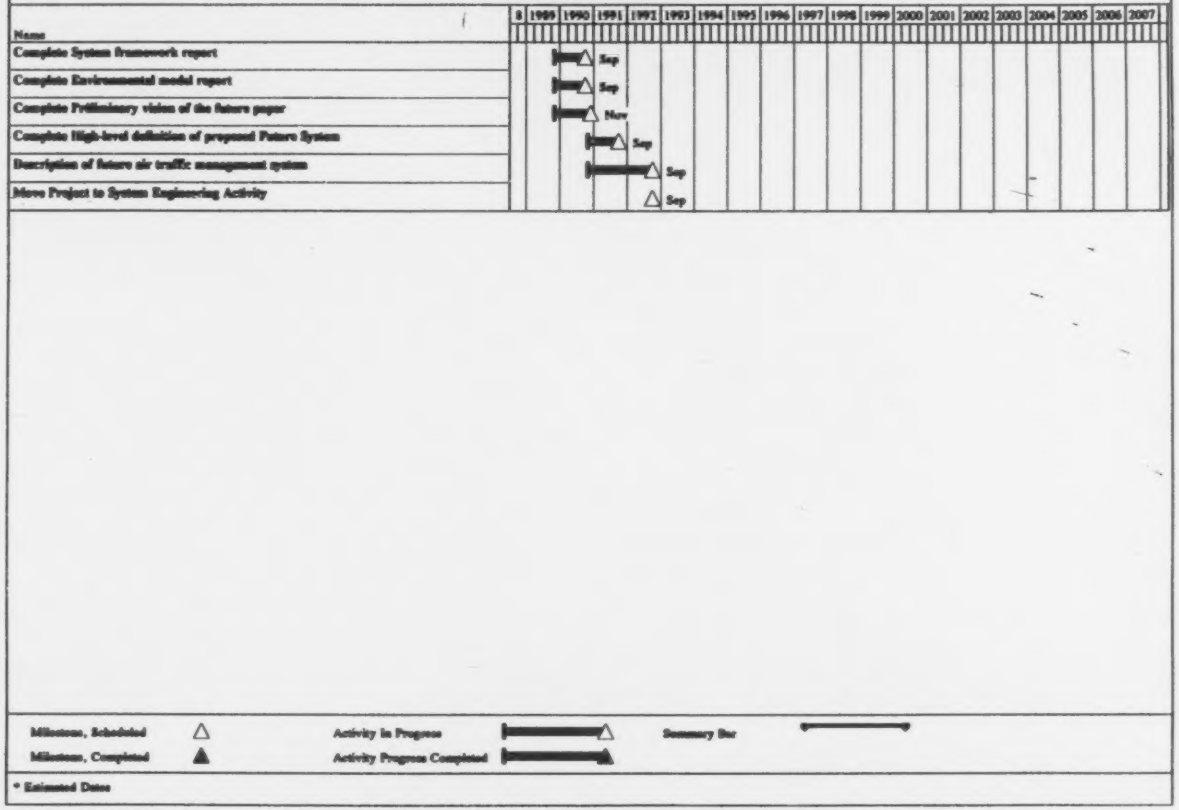


* Estimated Dates

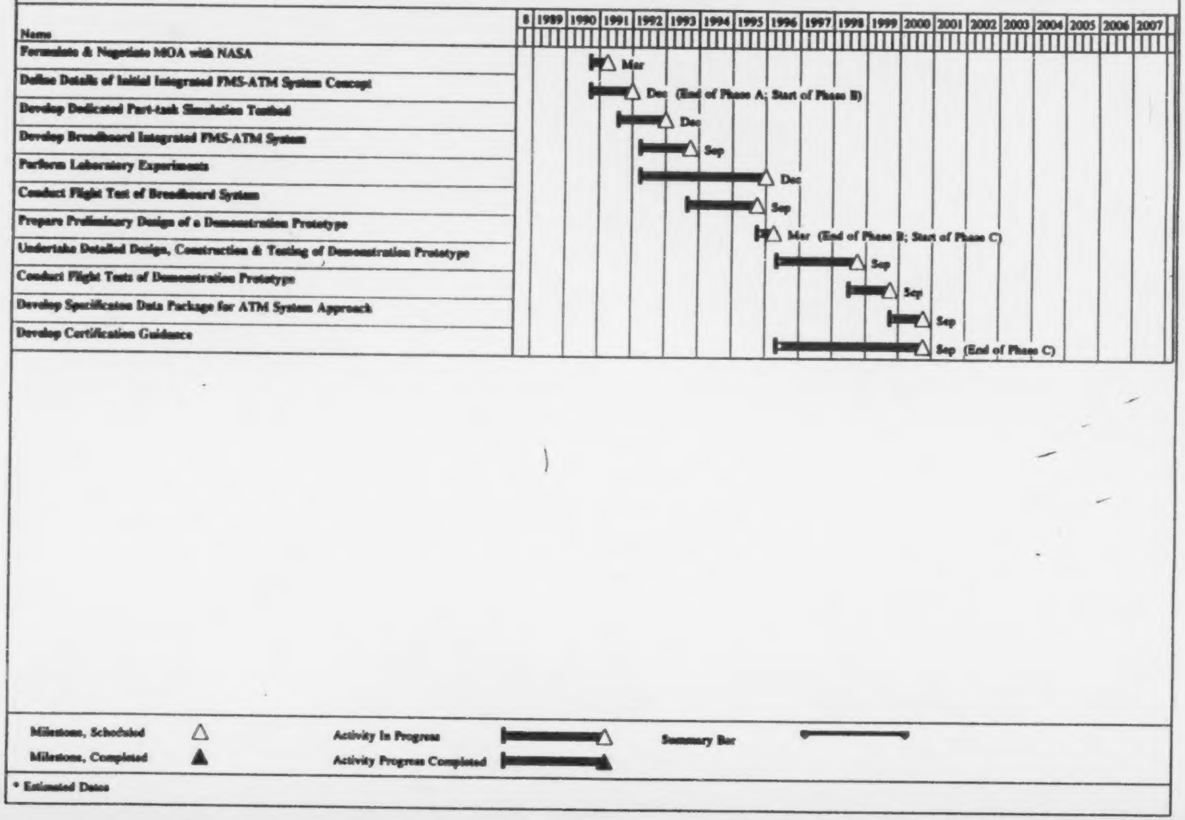
Vertical Flight Operations & Certification



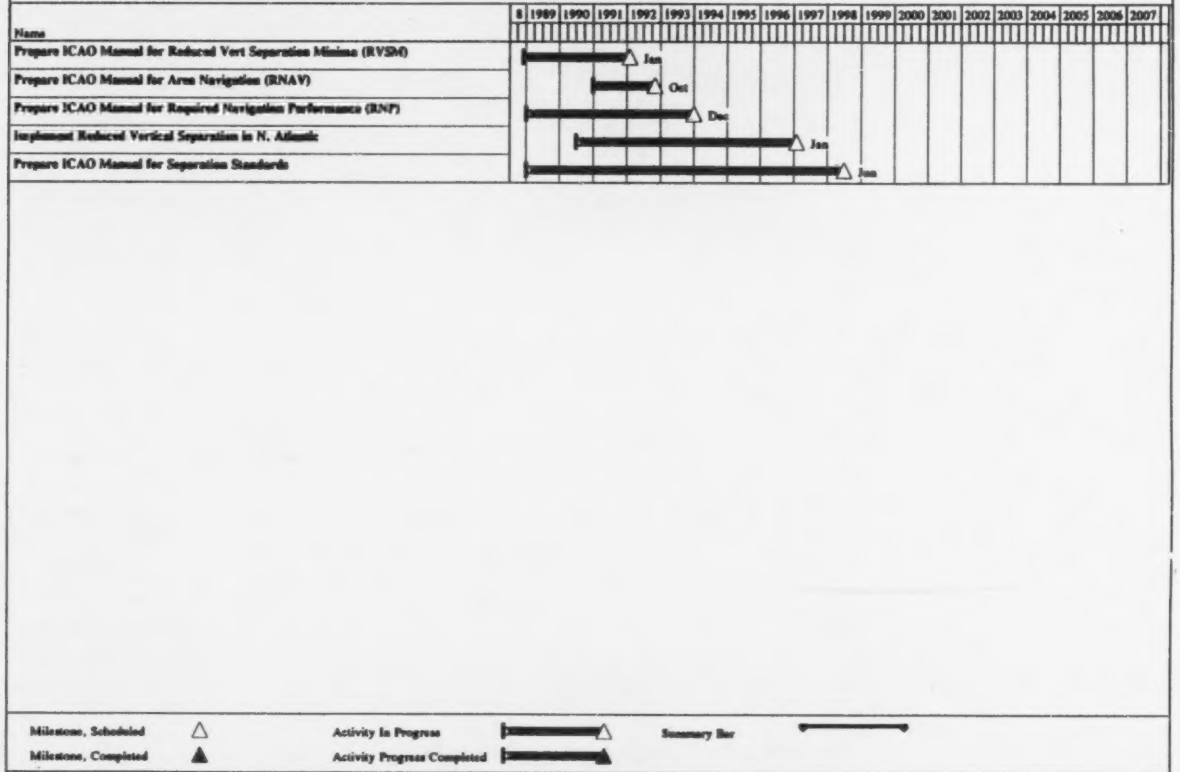
Future System Definition



Flight Operations and ATM Integration



Separation Standards



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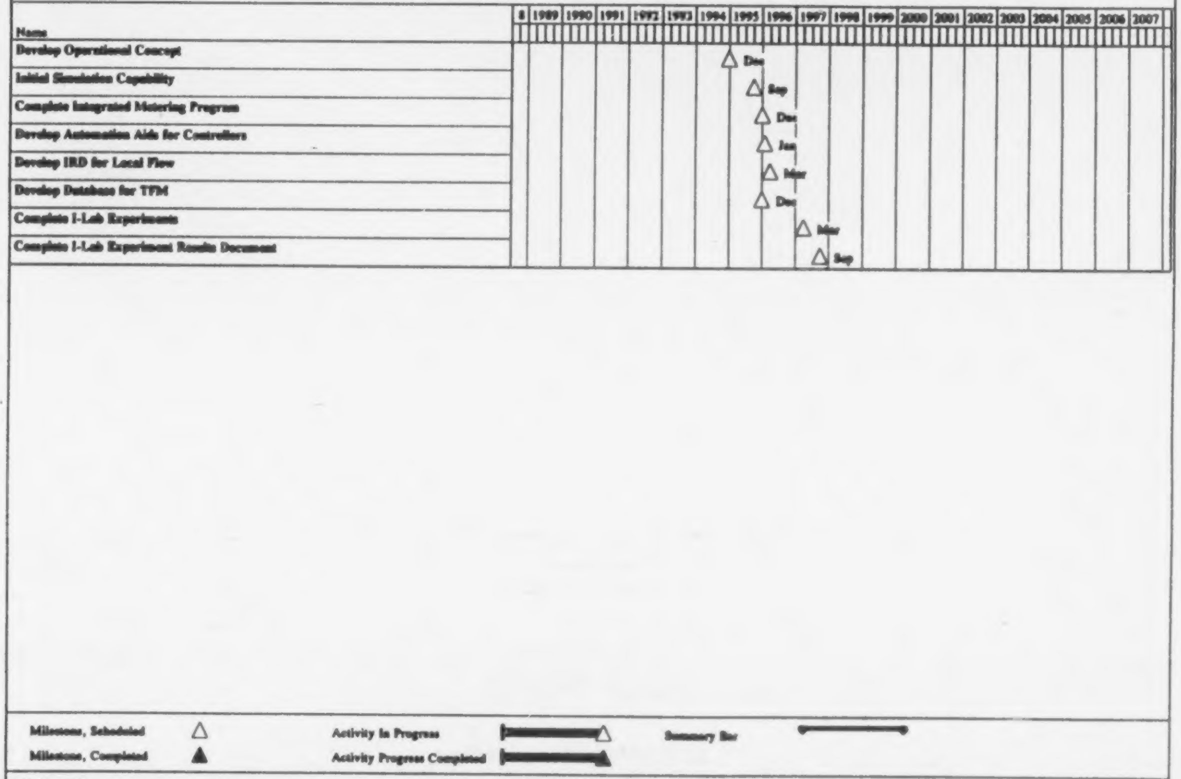
Integrated Traffic Flow Management



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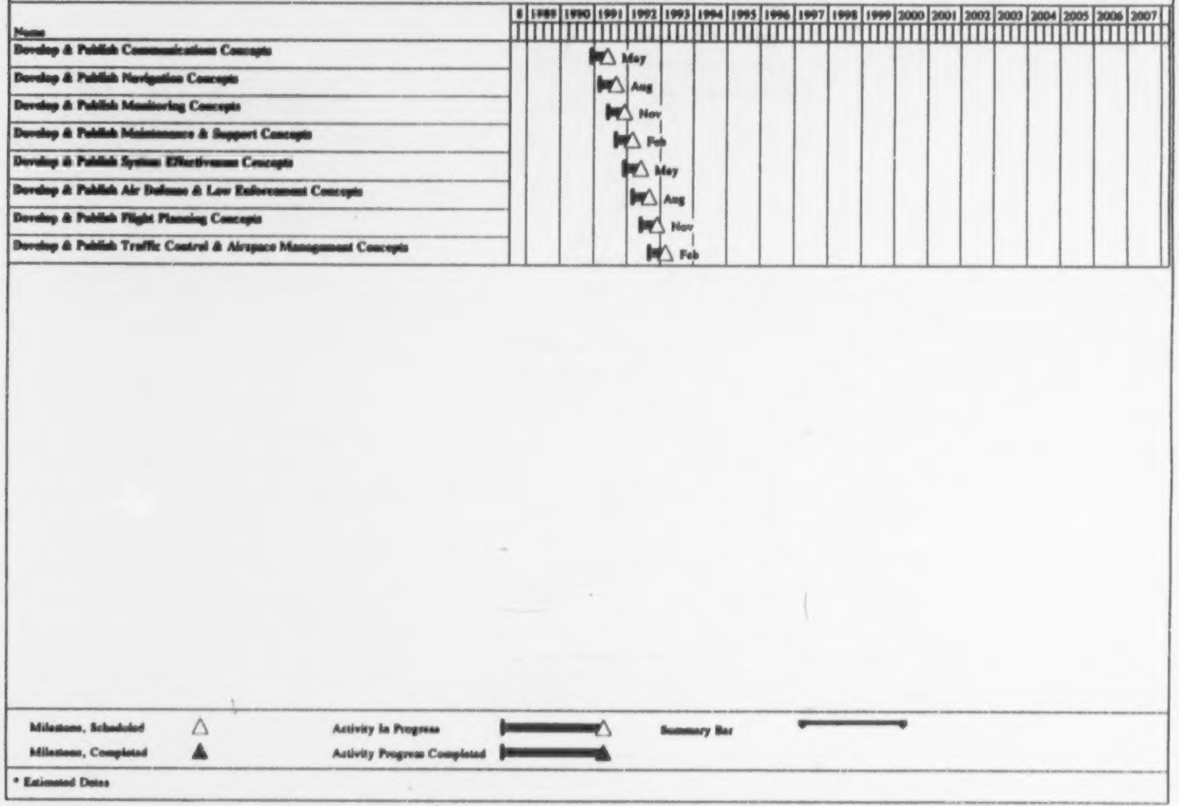
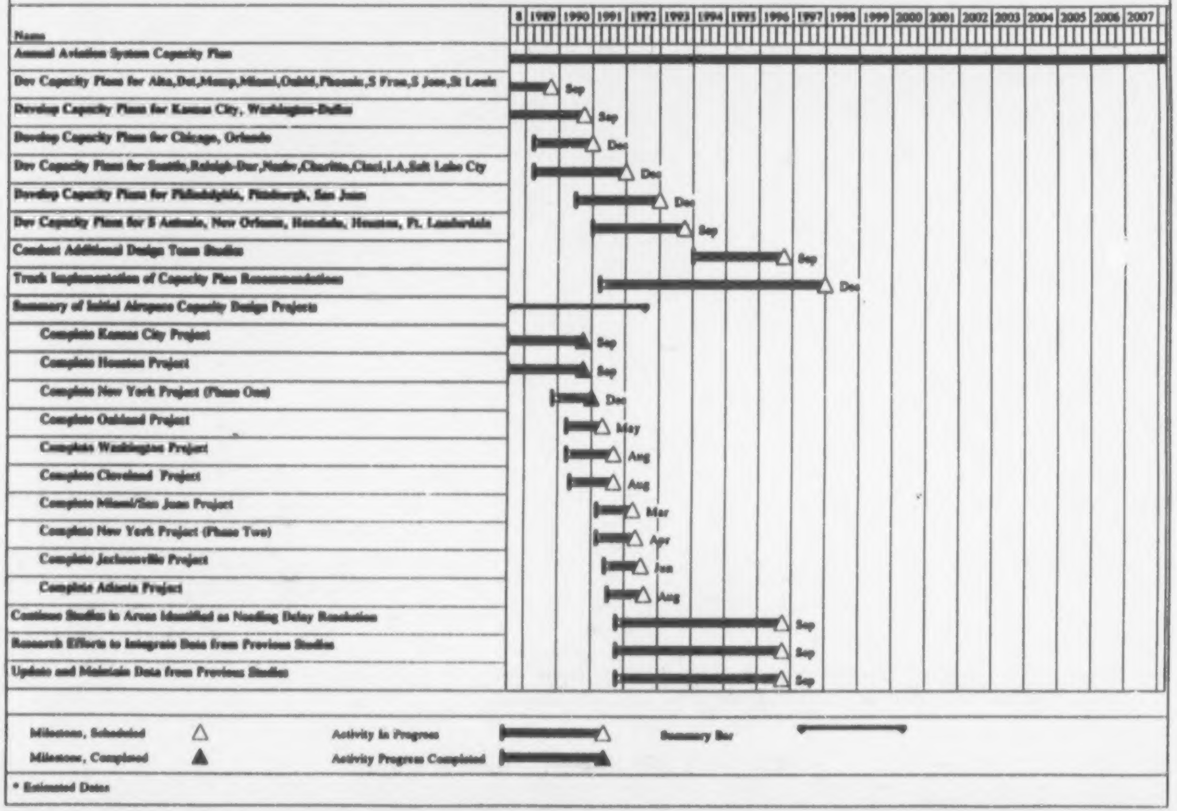
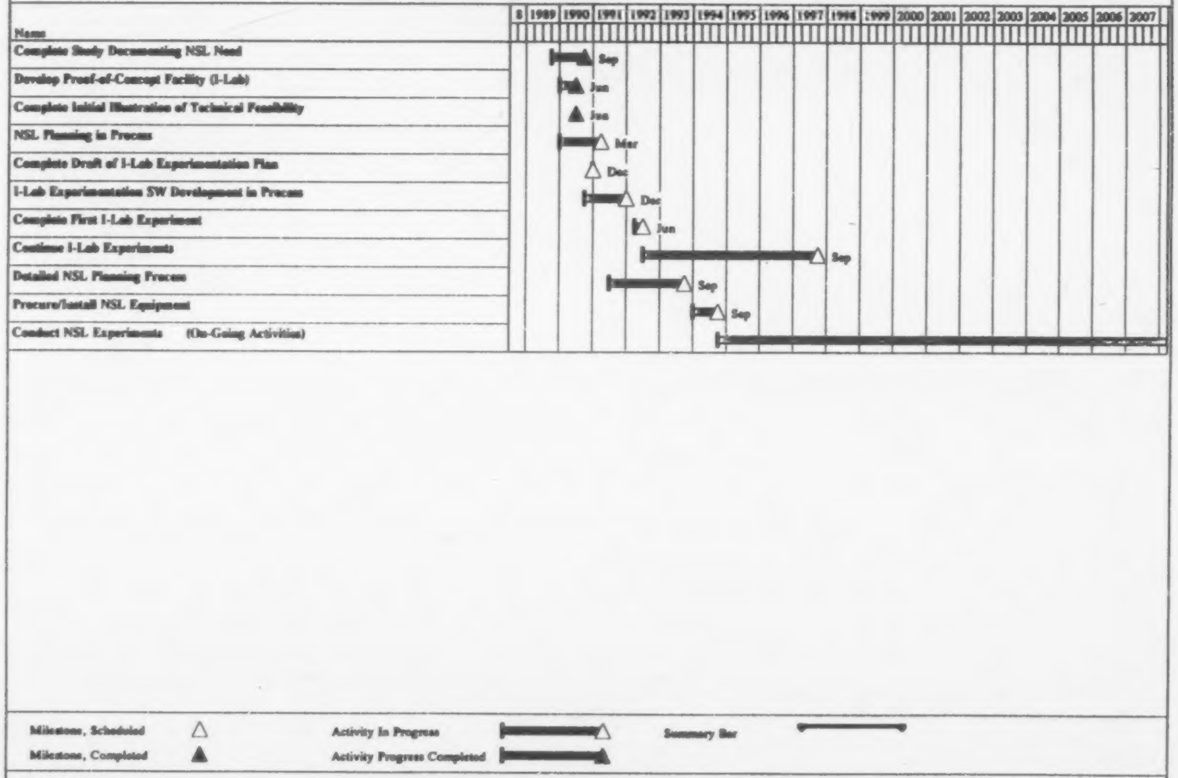
NAS System Operational Concepts



Aviation System Capacity Planning



National Simulation Laboratory (NSL)



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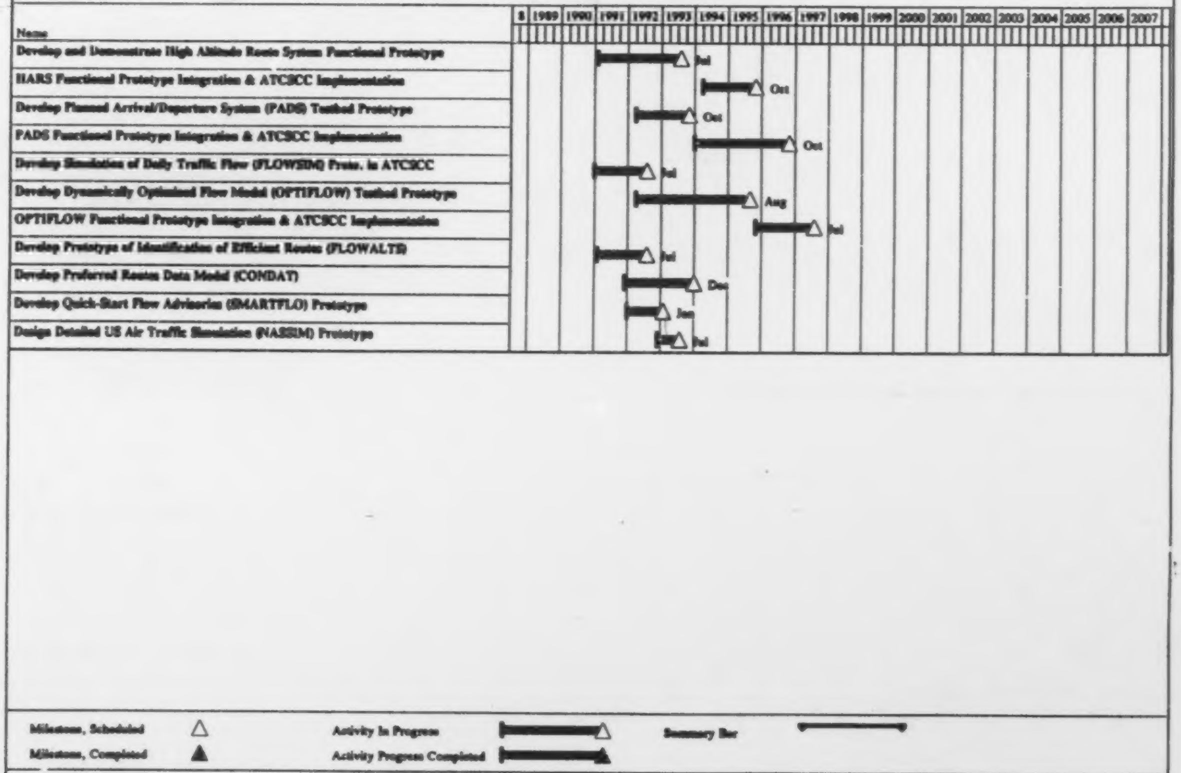
Operational Traffic Flow Planning



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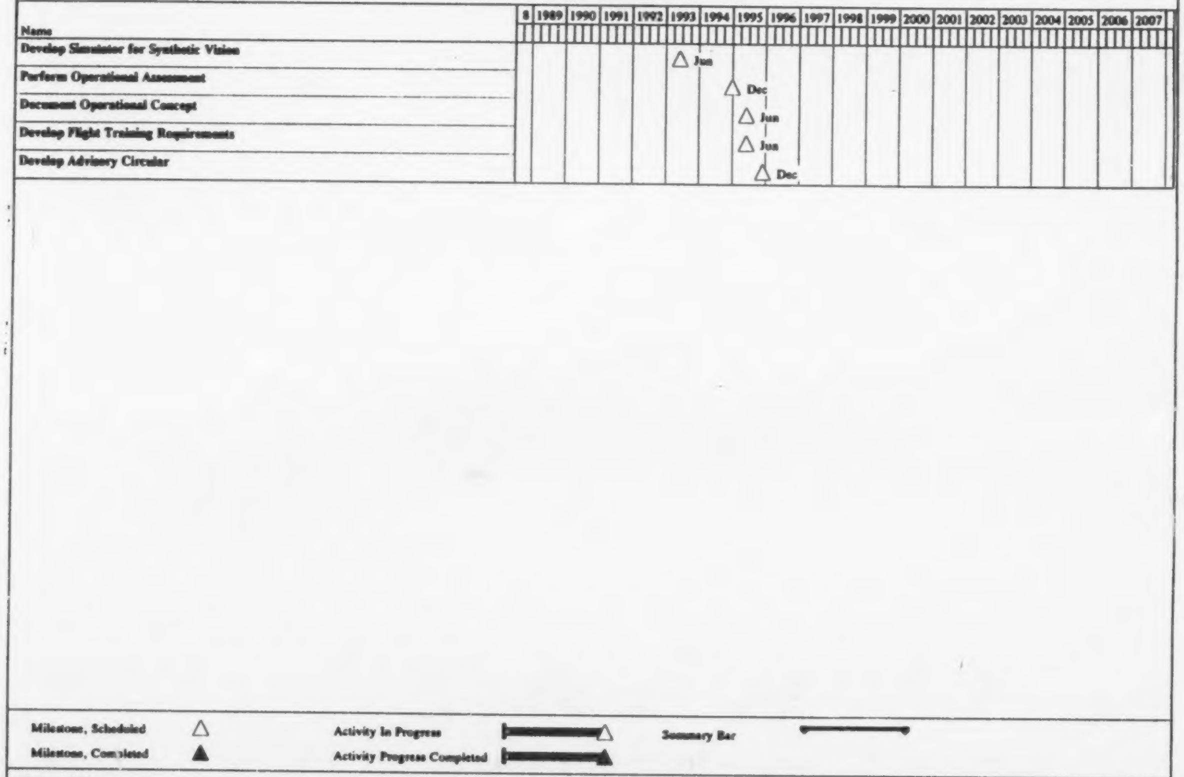
Synthetic Vision



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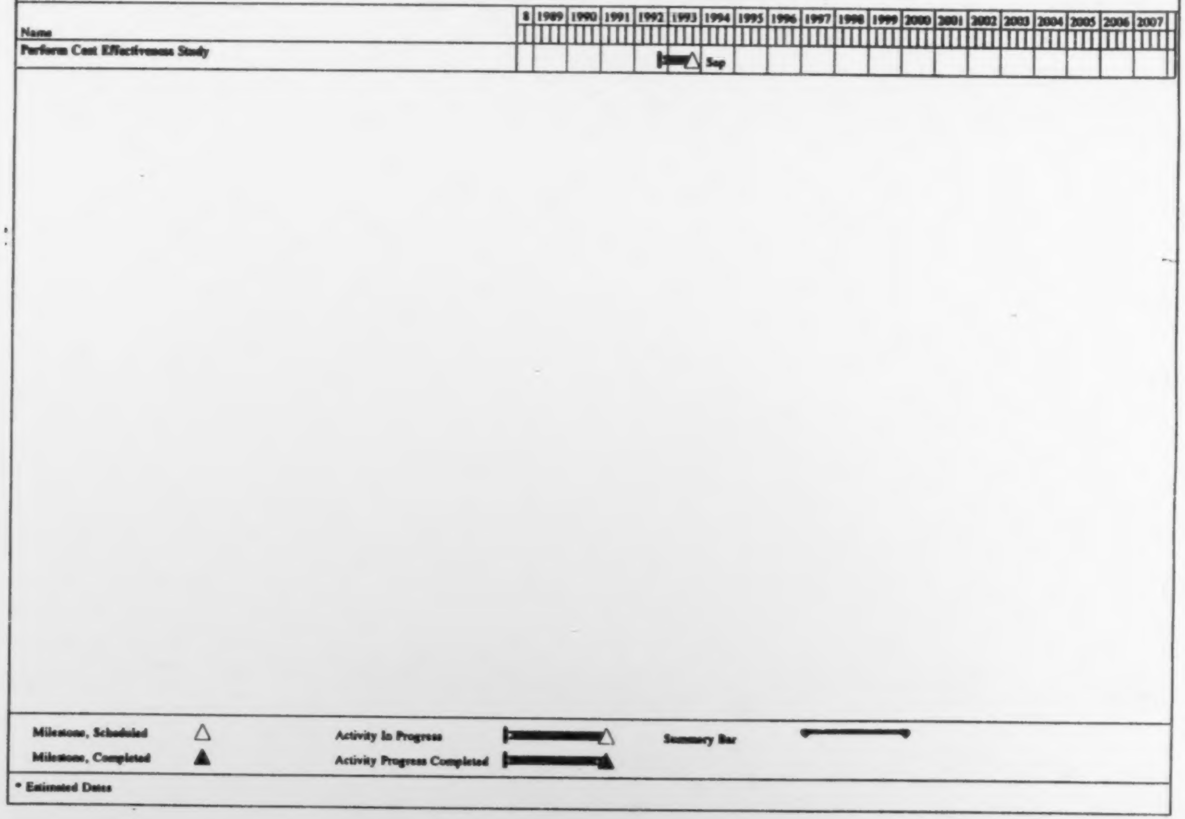
Small Airport Sensor



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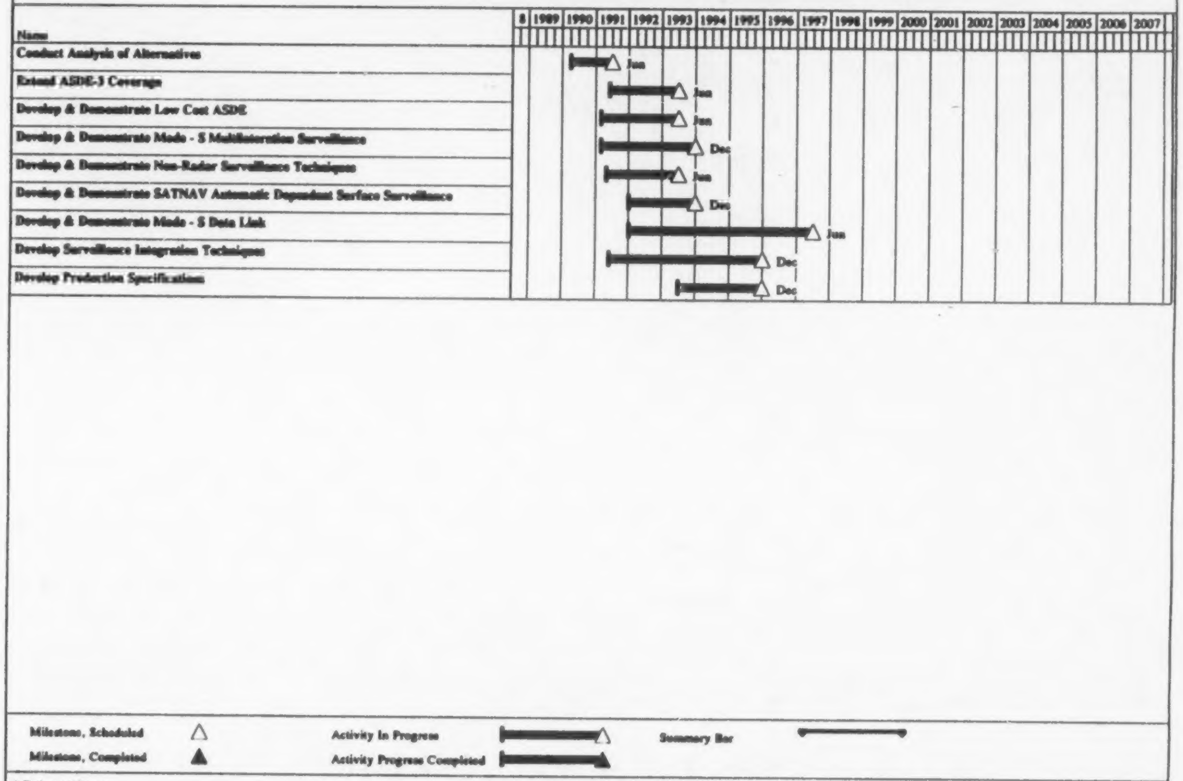
Airport Surface Surveillance (P/O ASTA)



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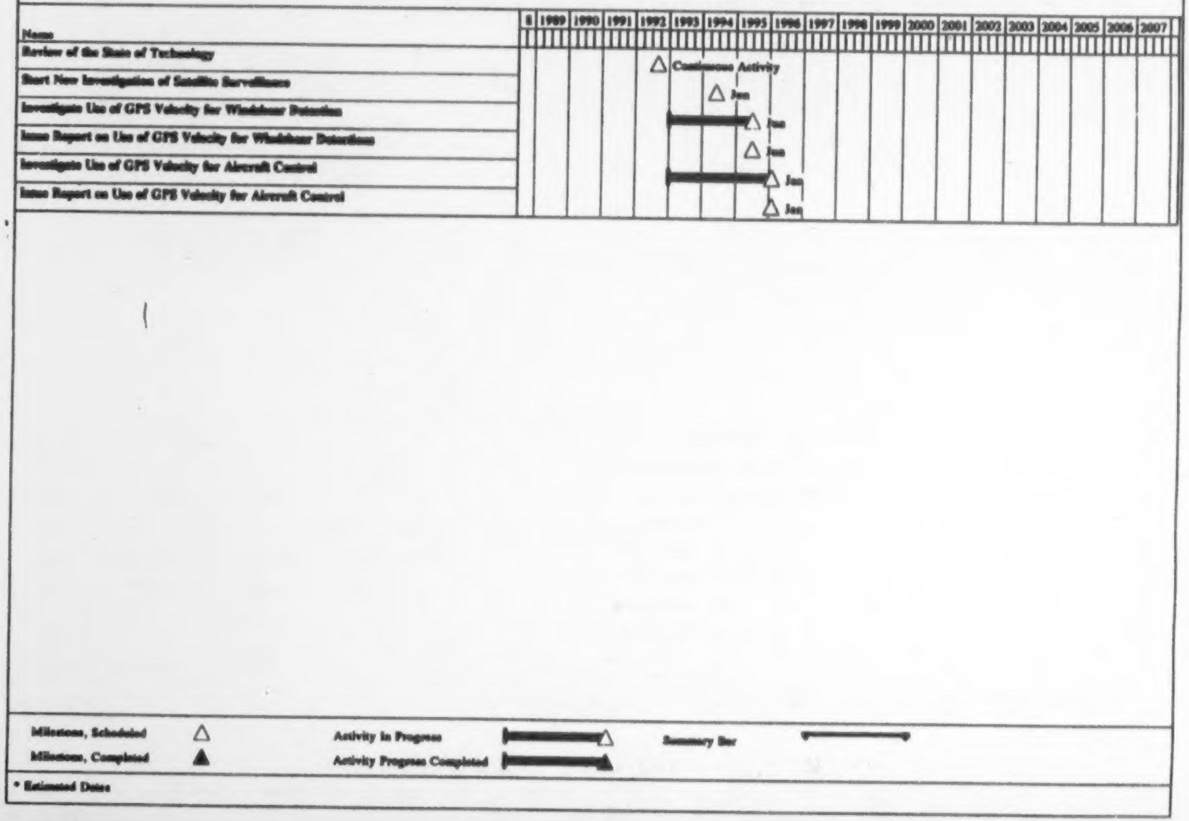
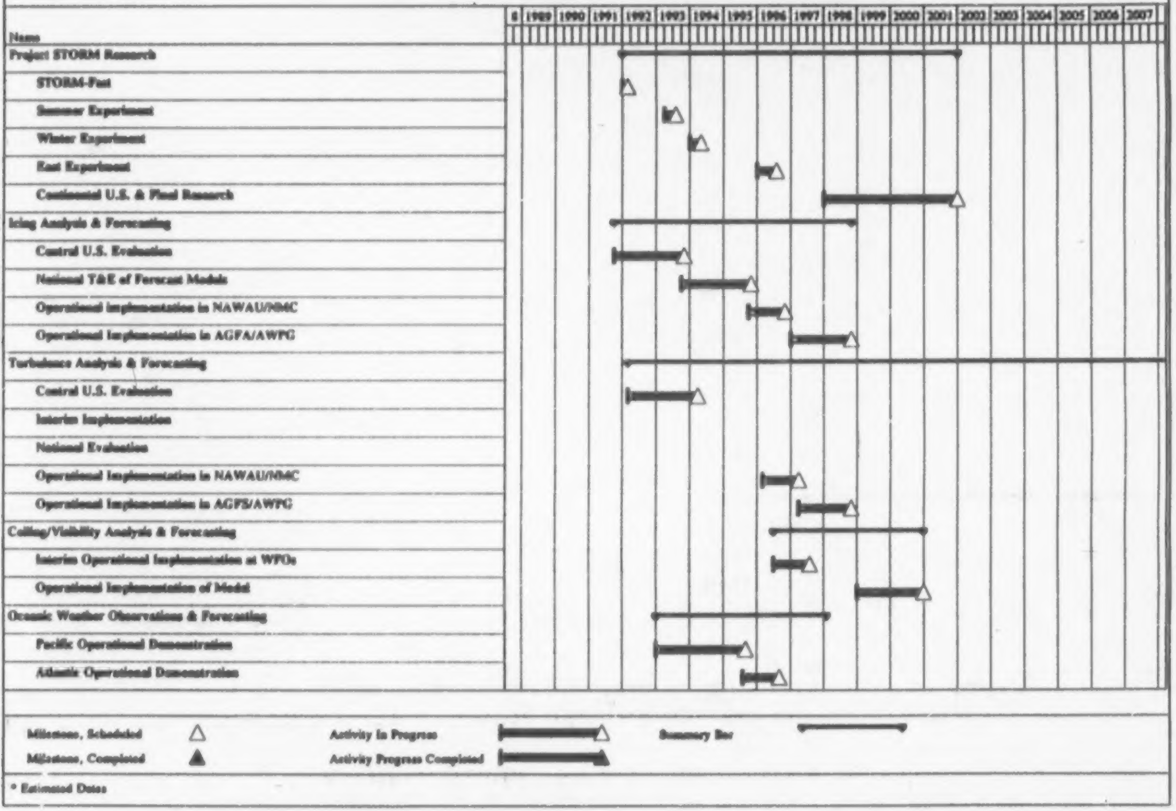
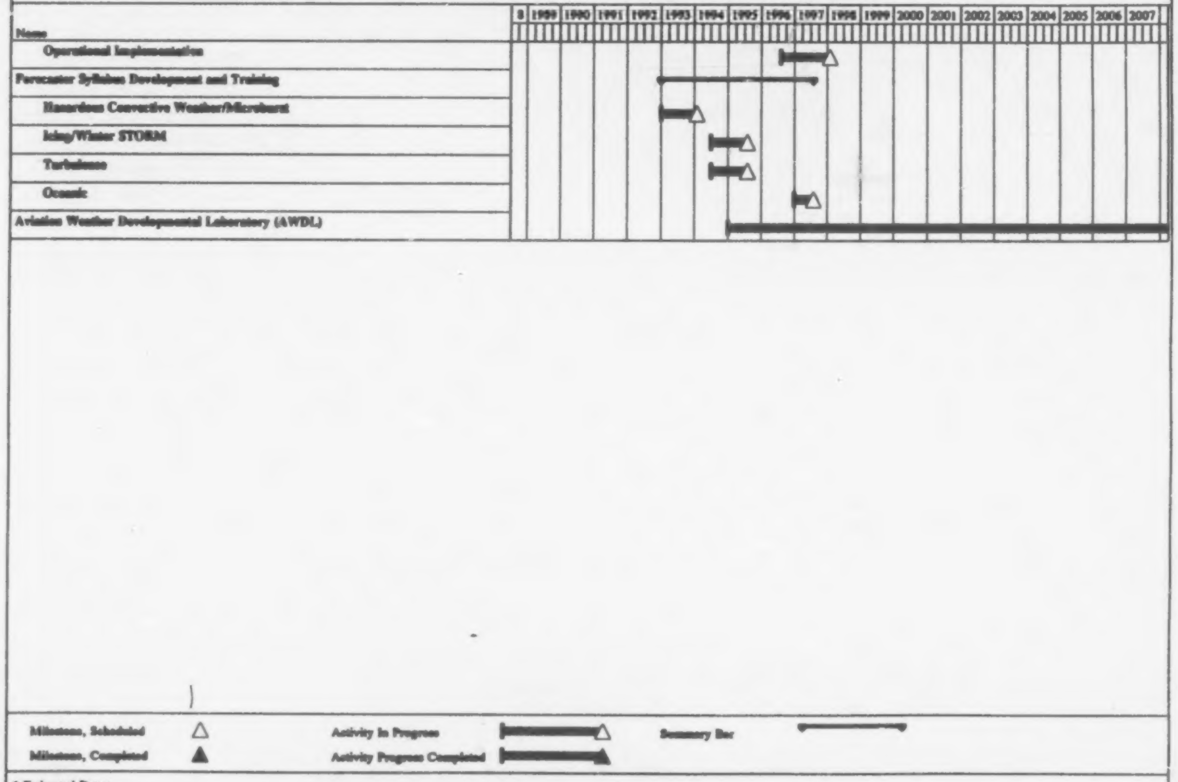
Aviation CNS Applications of Technology



Aviation Weather Analysis and Forecasting



Aviation Weather Analysis and Forecasting



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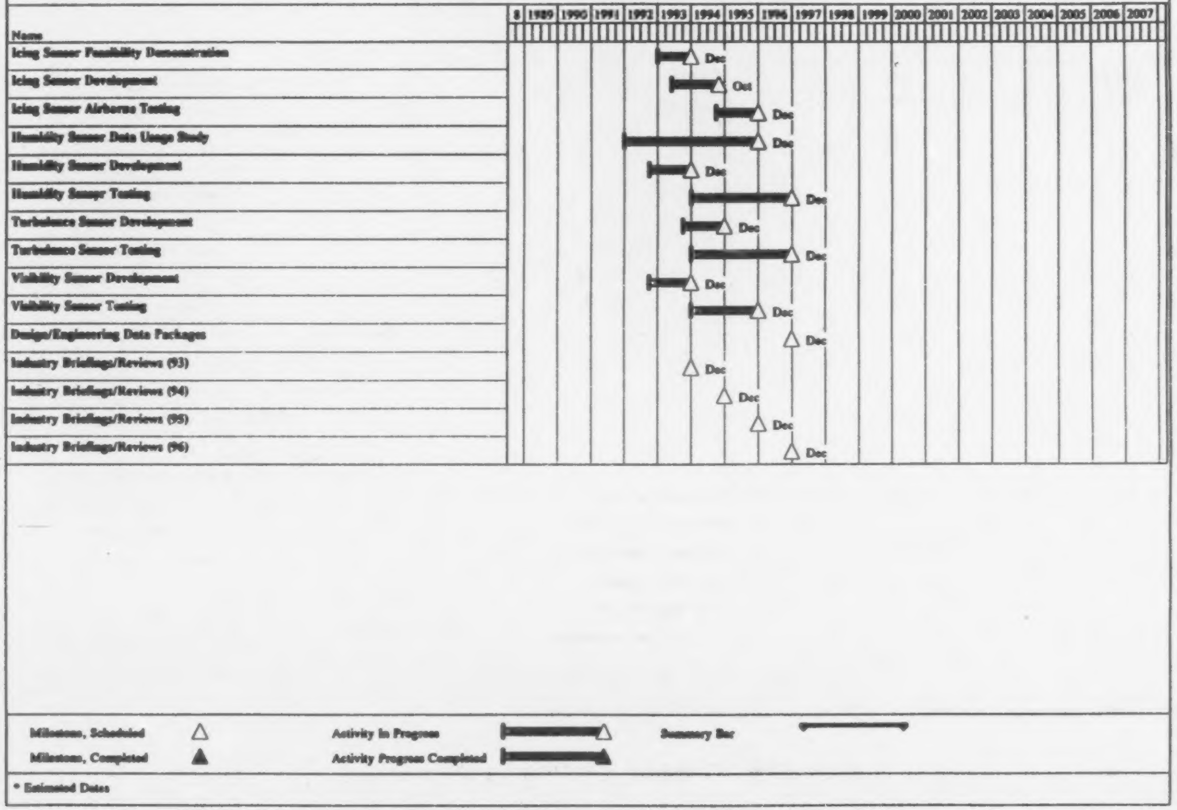
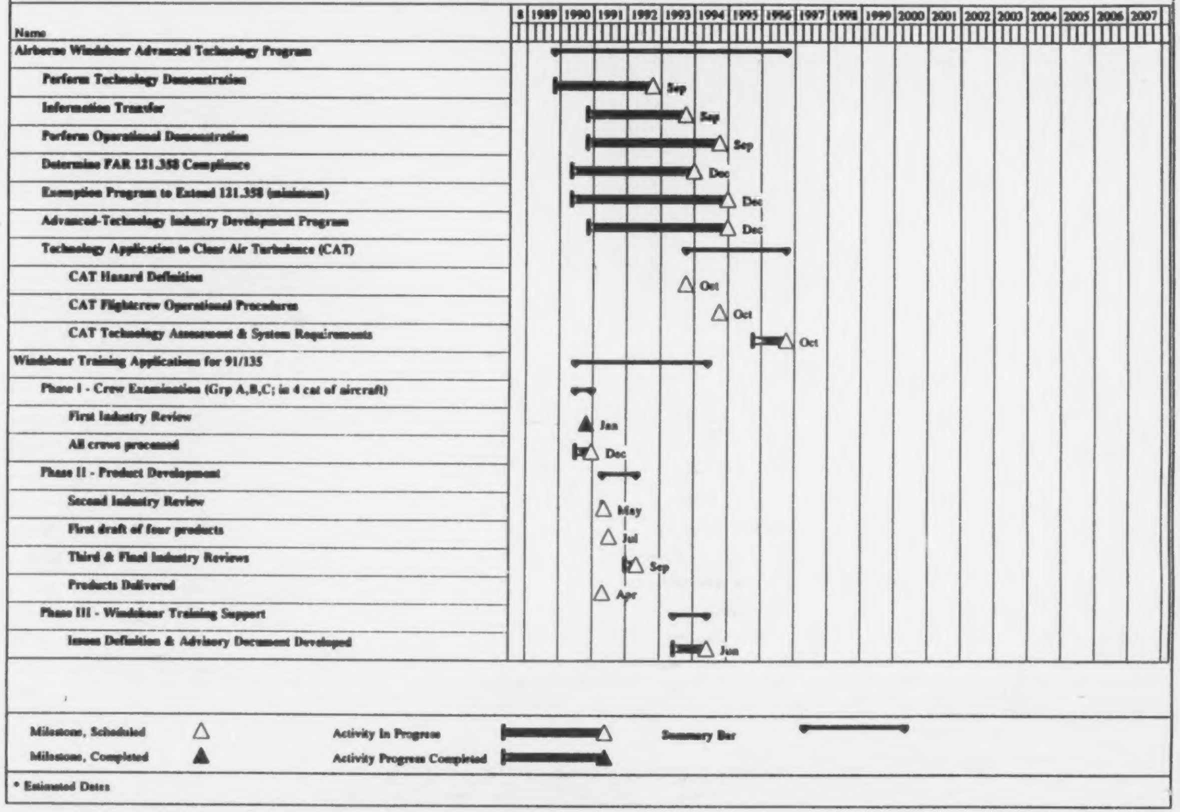
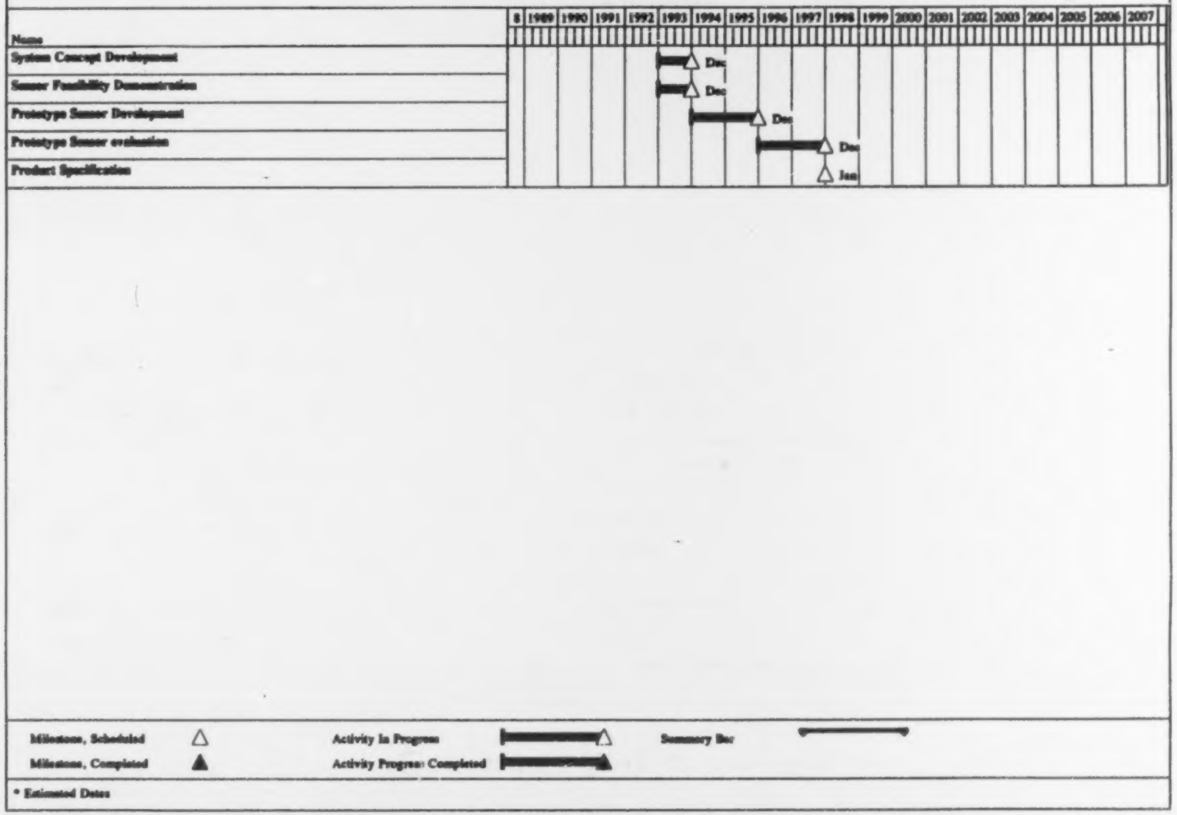
Airborne Meteorological Sensors



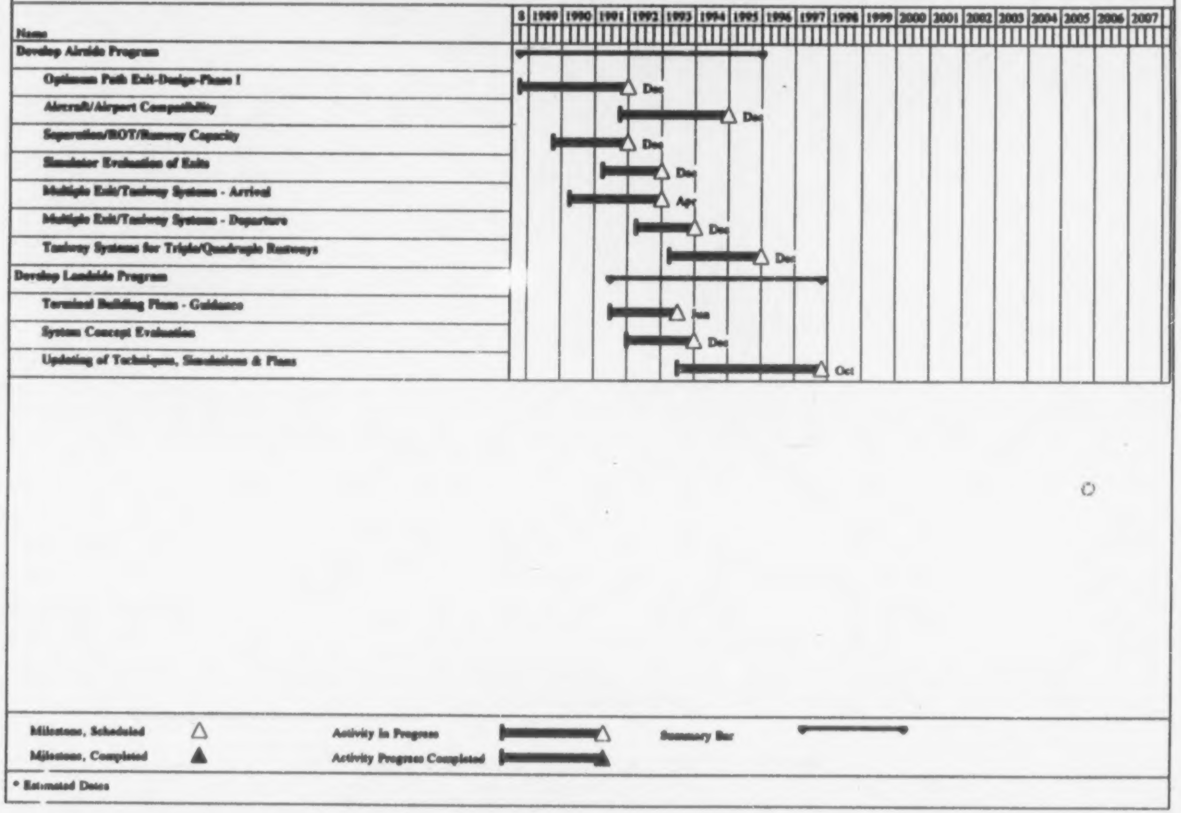
Integrated Airborne Windshear Research



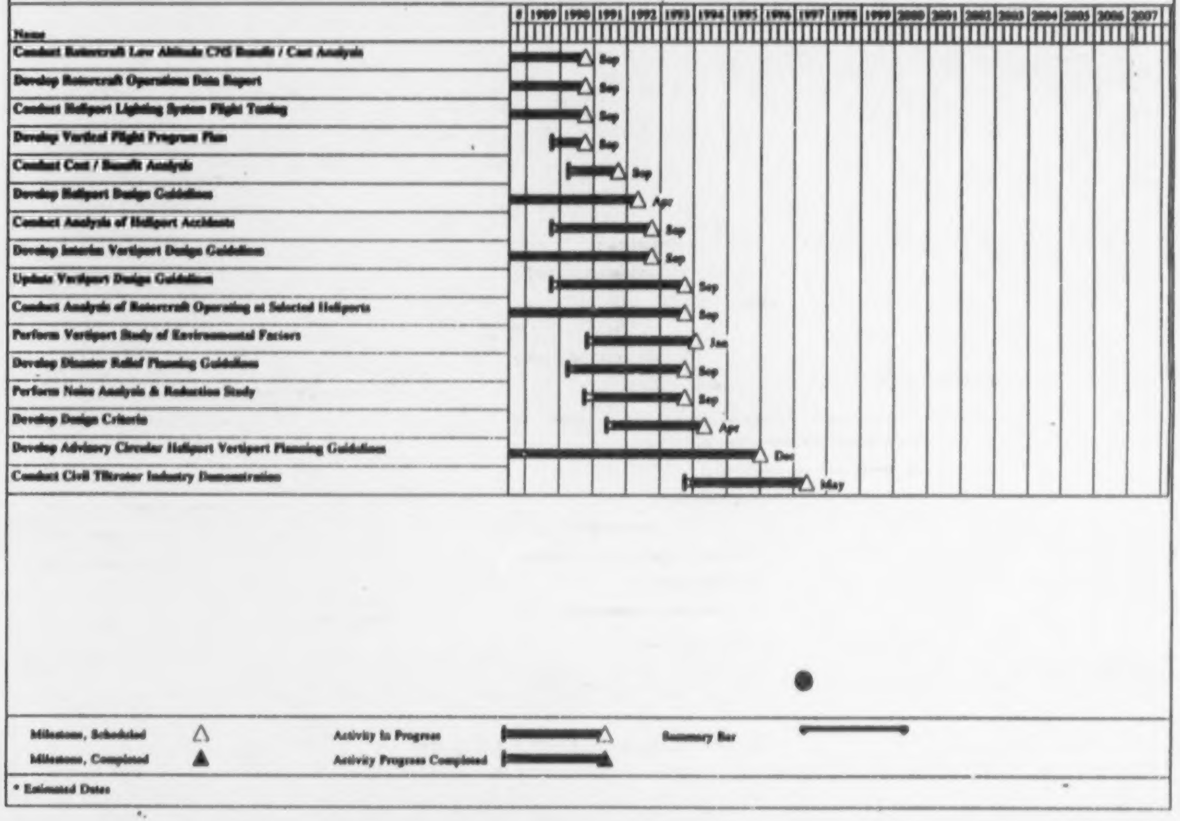
Slant Range Runway Visibility Sensor



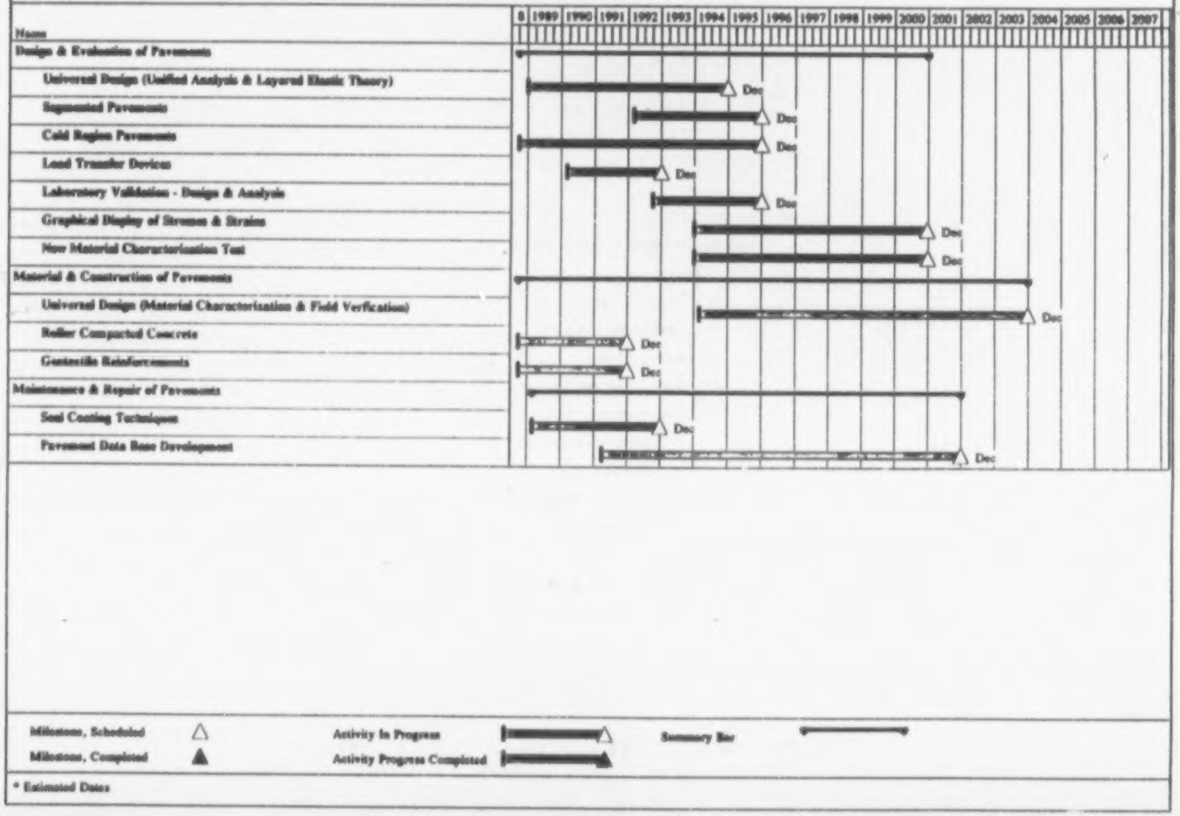
Airport Planning & Design Technology



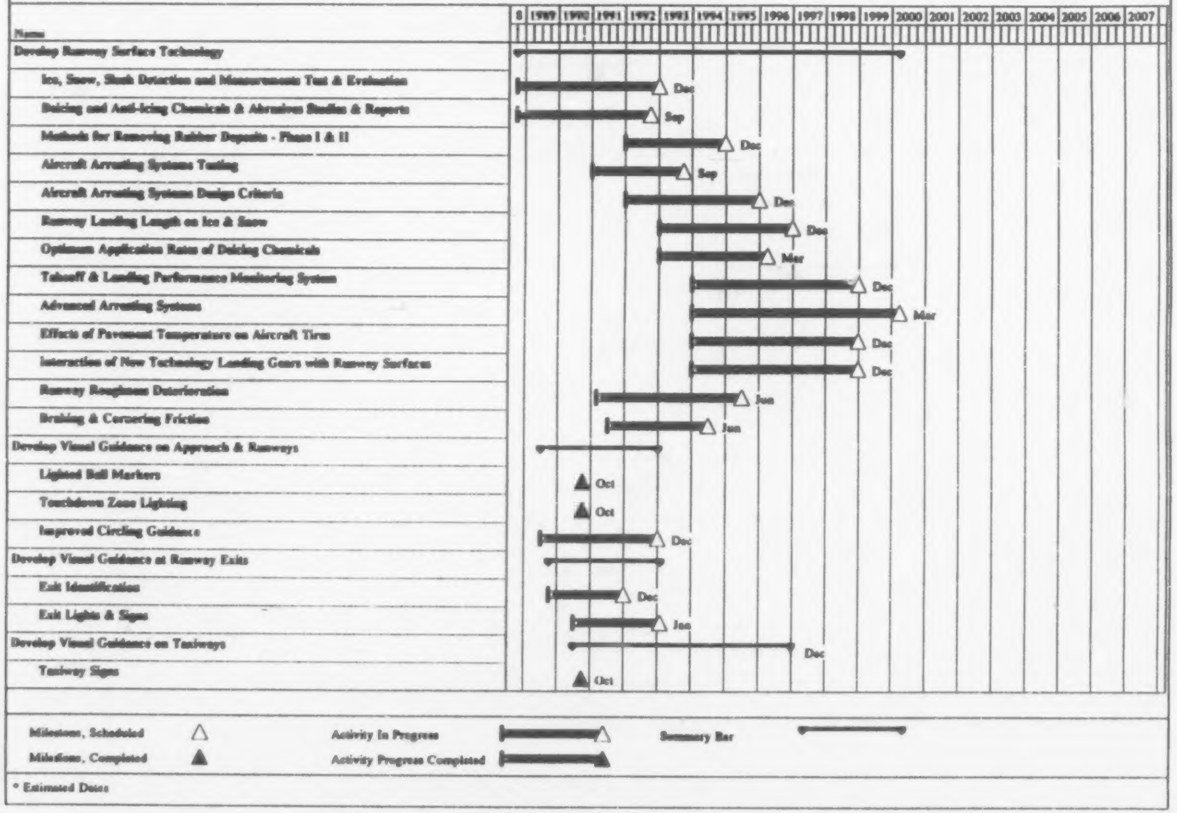
Heliport / Vertiport Design Technology



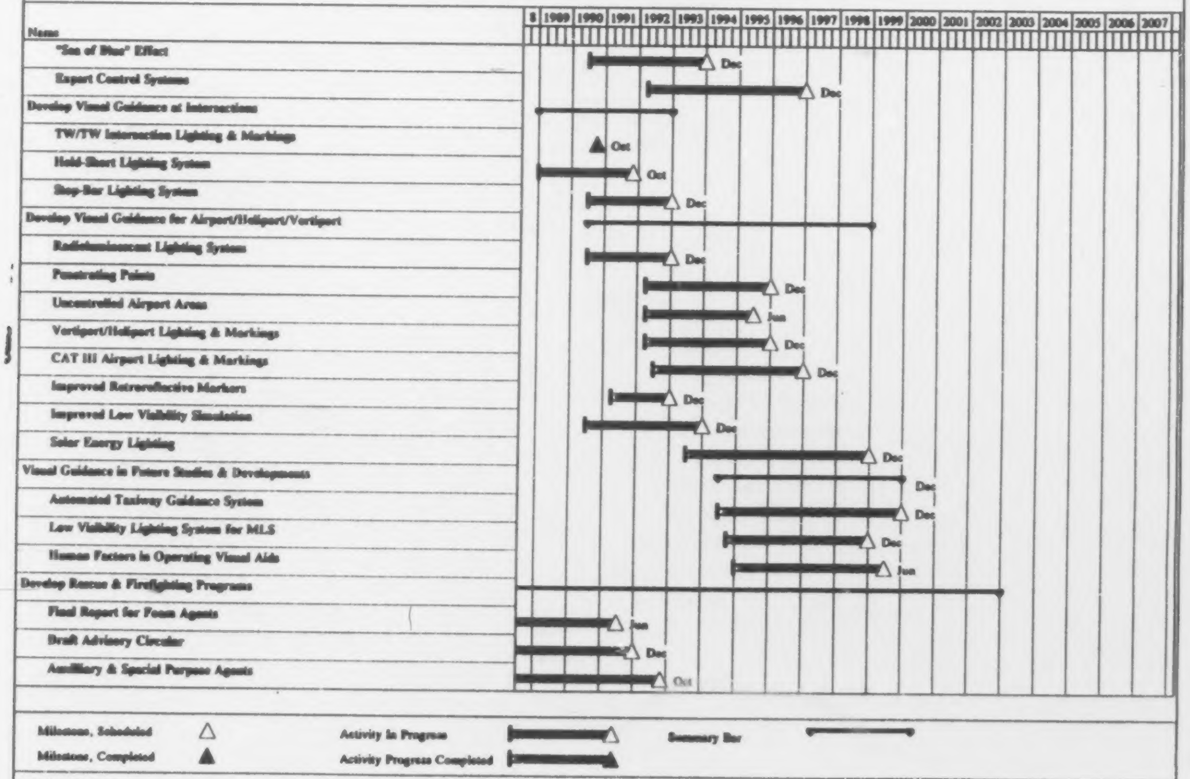
Airport Pavement Technology



Airport Safety Technology

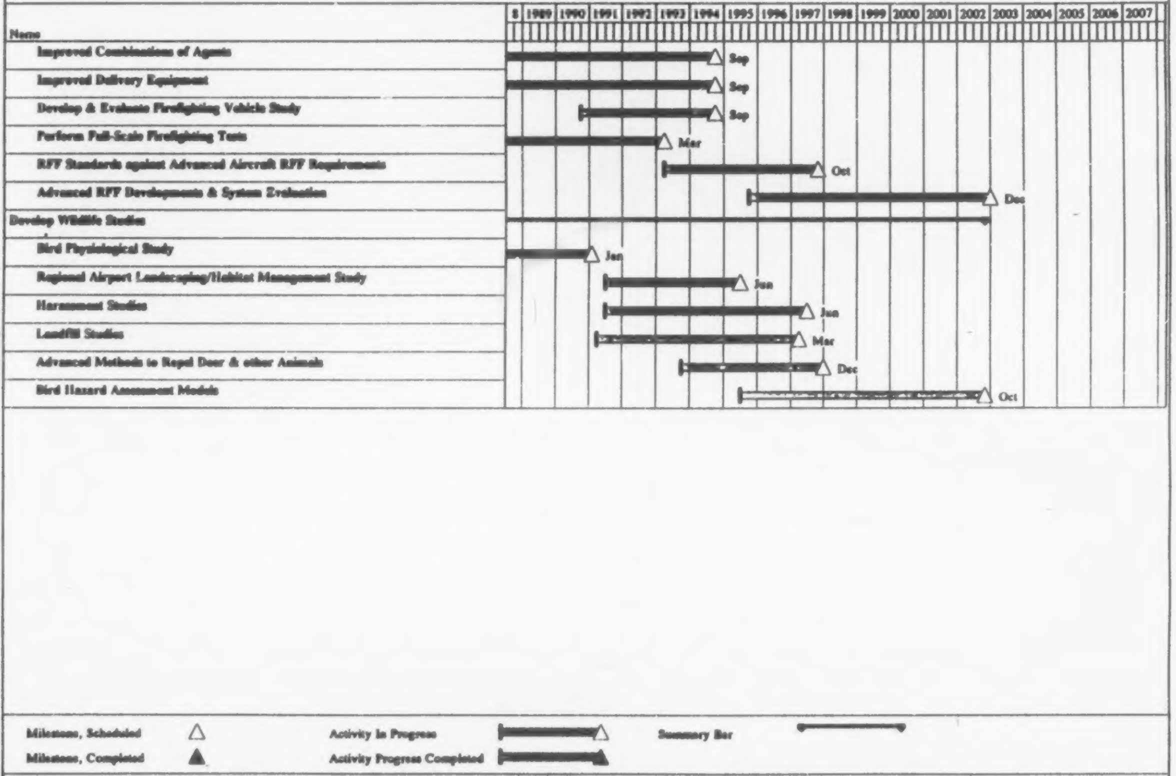


Airport Safety Technology



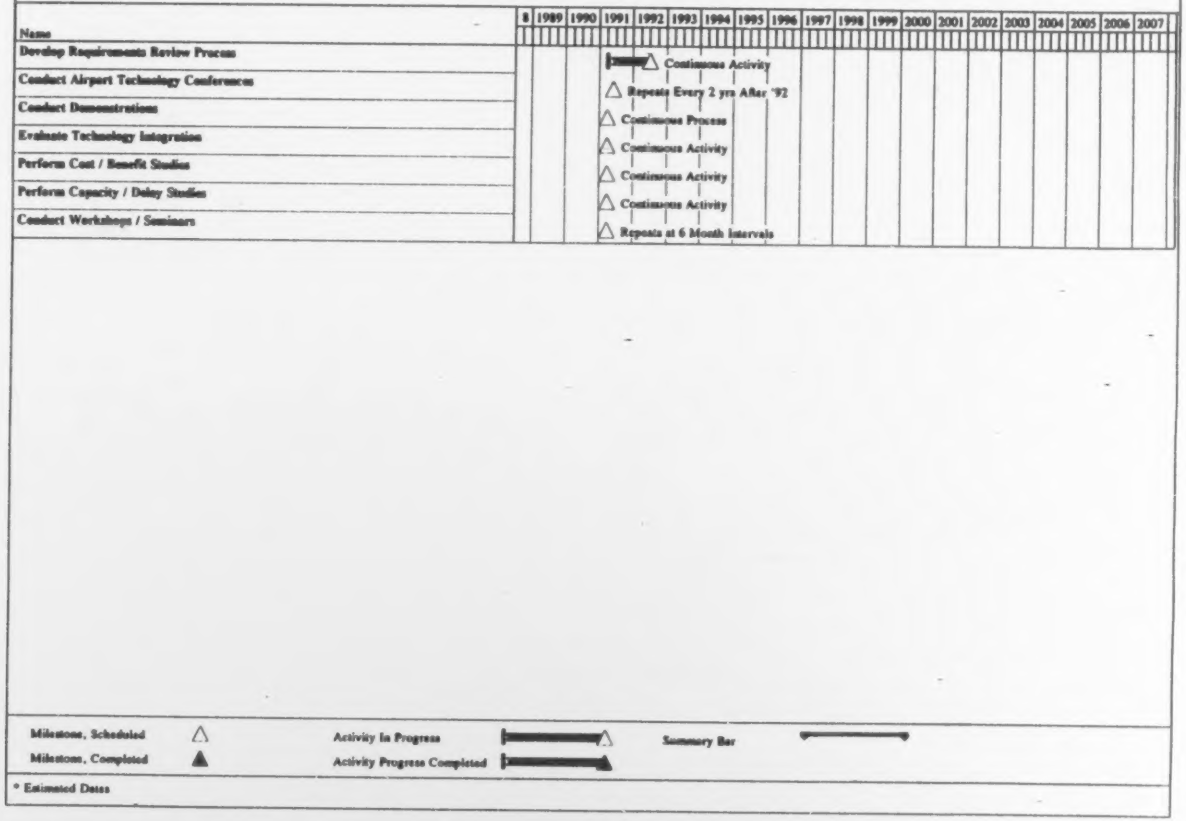
* Estimated Dates

Airport Safety Technology

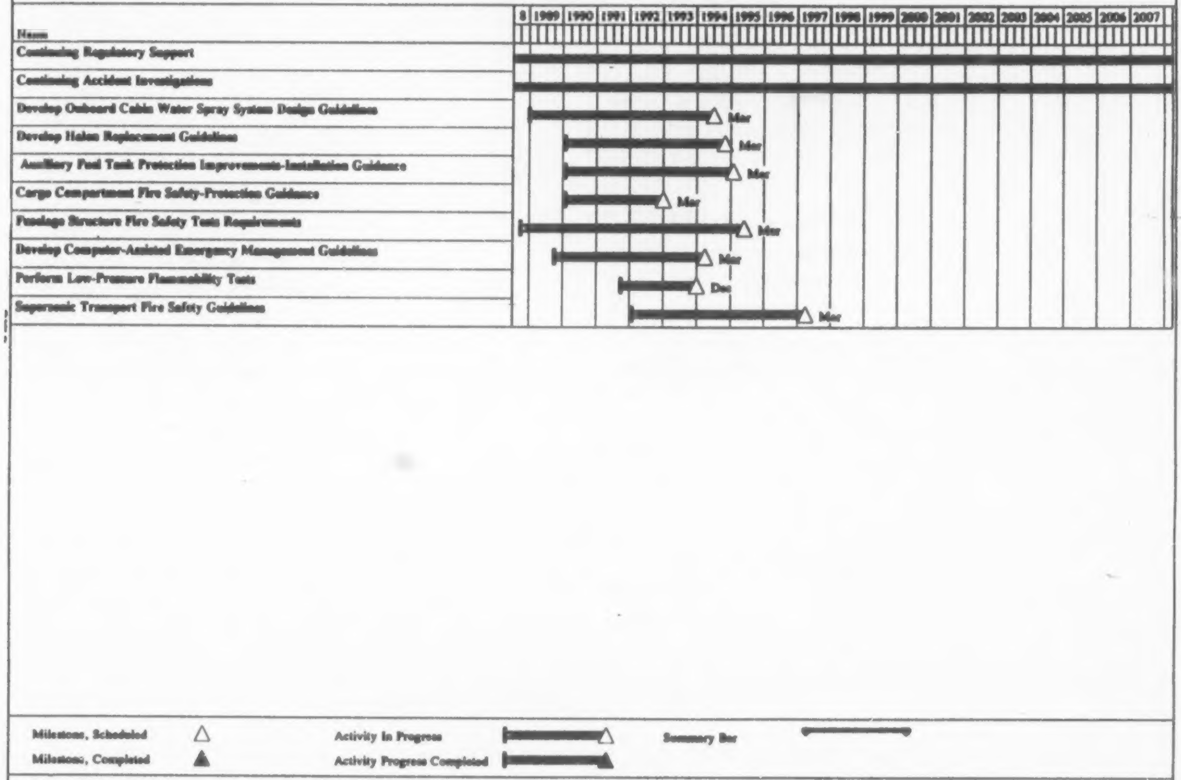


* Estimated Dates

Advanced Systems & Concepts Evaluation

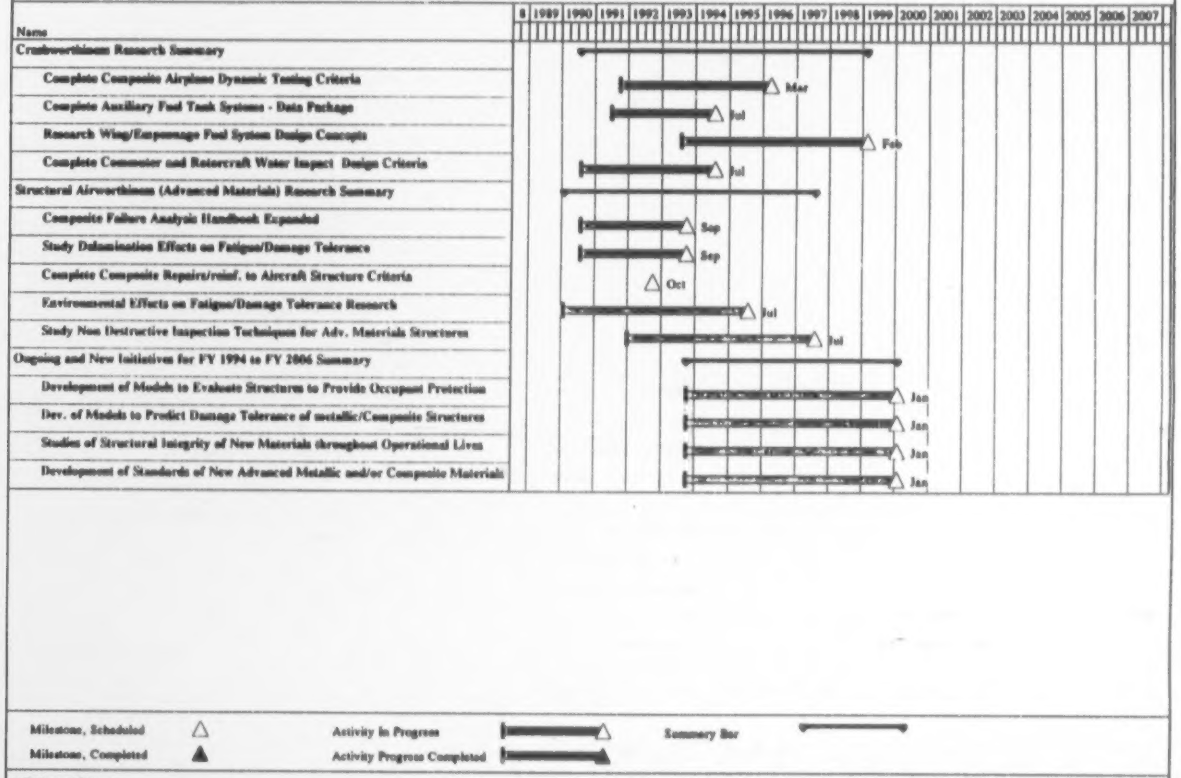


Aircraft Systems Fire Safety



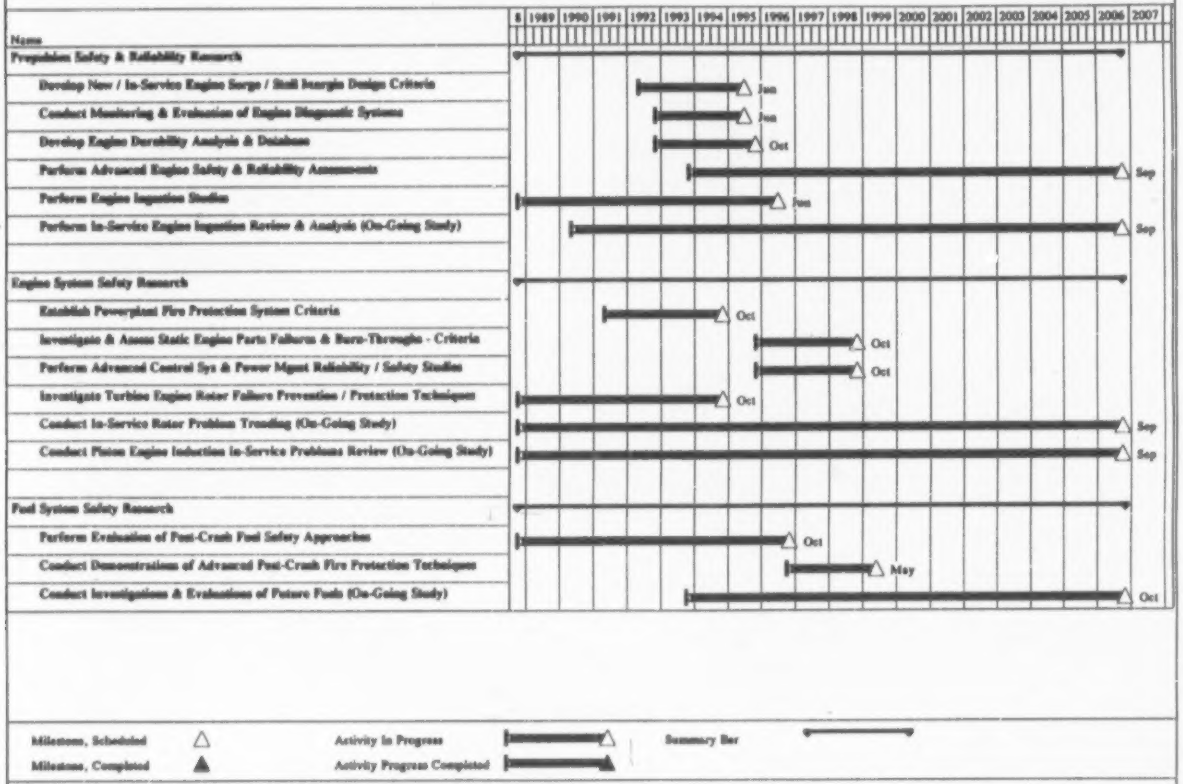
* Estimated Dates

Crashworthiness/Structural Airworthiness



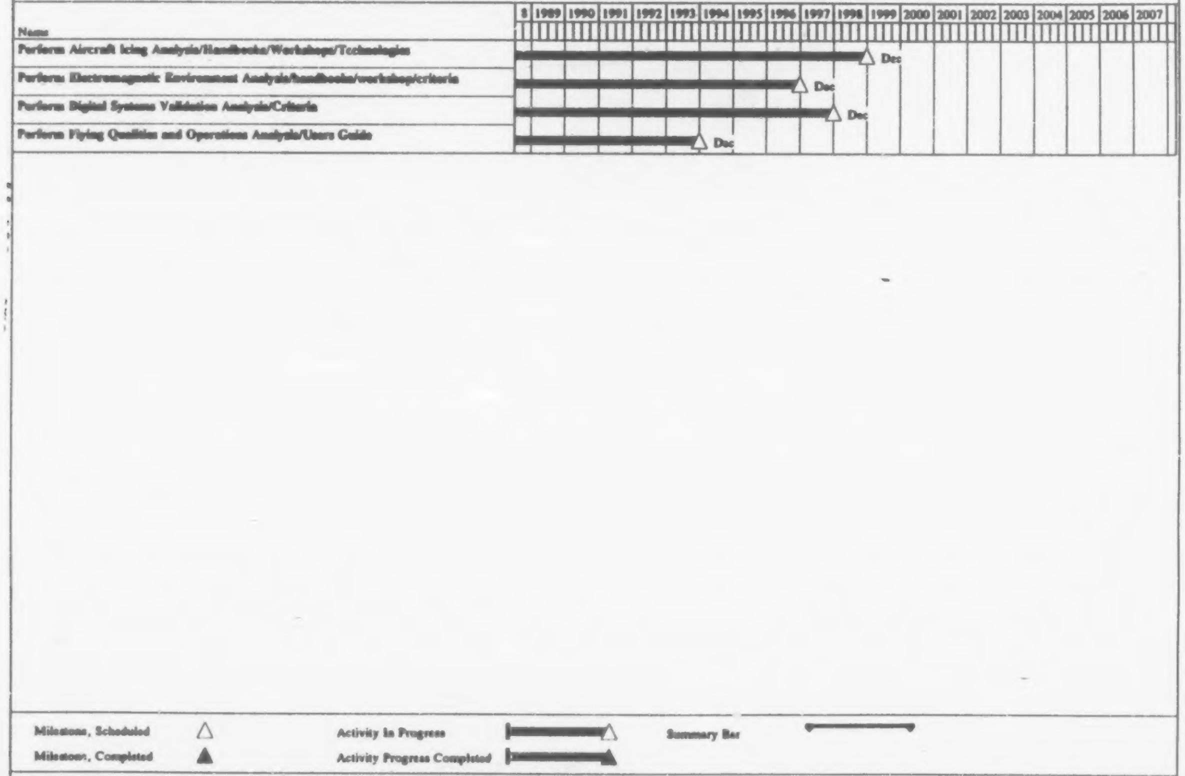
* Estimated Dates.

Propulsion & Fuel Systems

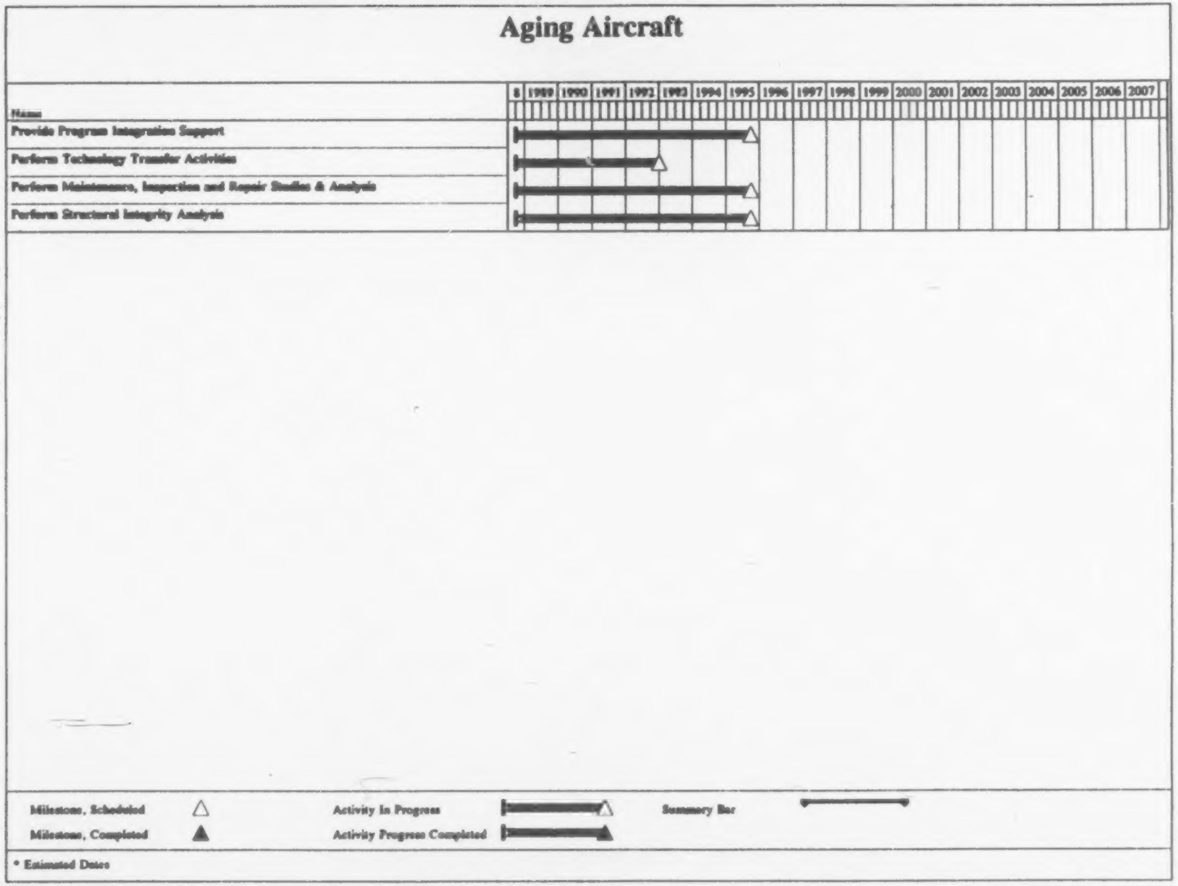


* Estimated Dates

Flight Safety/Atmospheric Hazards Research



* Estimated Dates

Aging Aircraft
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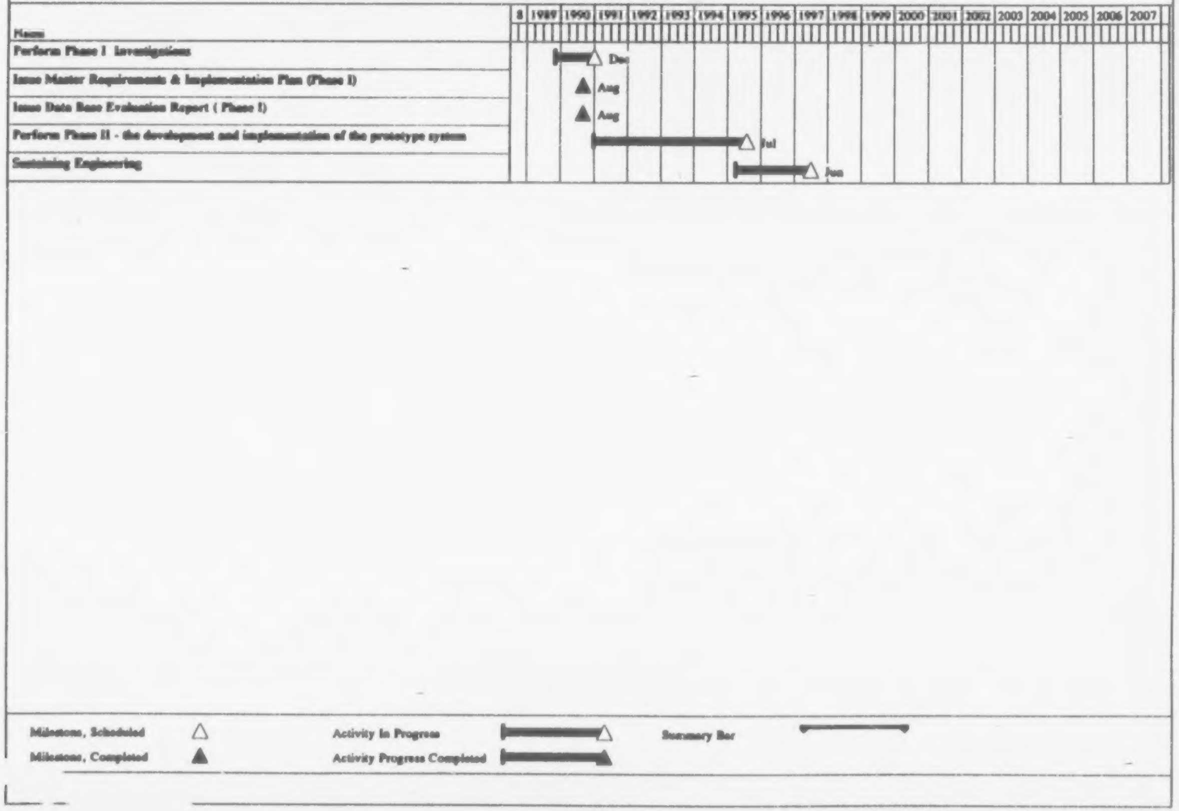
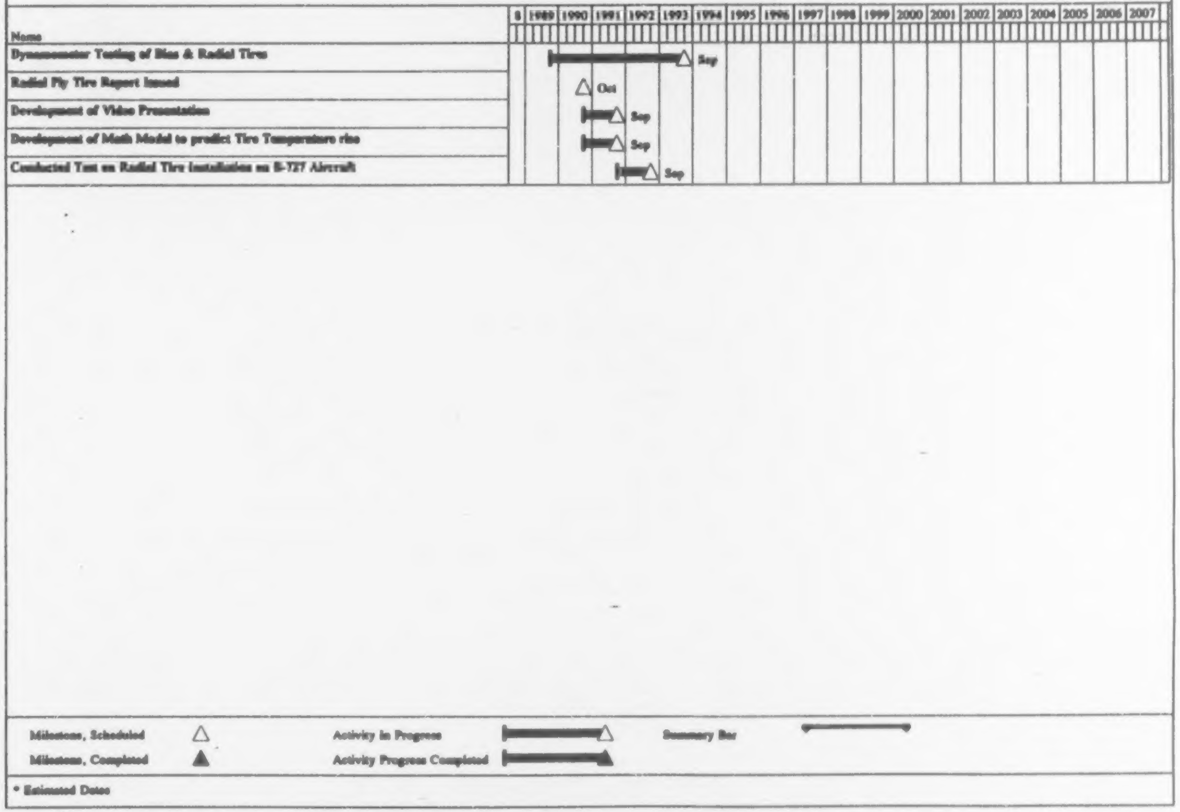
Provide Program Integration Support
Perform Technology Transfer Activities
Perform Maintenance, Inspection and Repair Studies & Analysis
Perform Structural Integrity Analysis
Milestone, Scheduled
Milestone, Completed
Activity In Progress
Activity Progress Completed
Summary Bar
* Estimated Dates

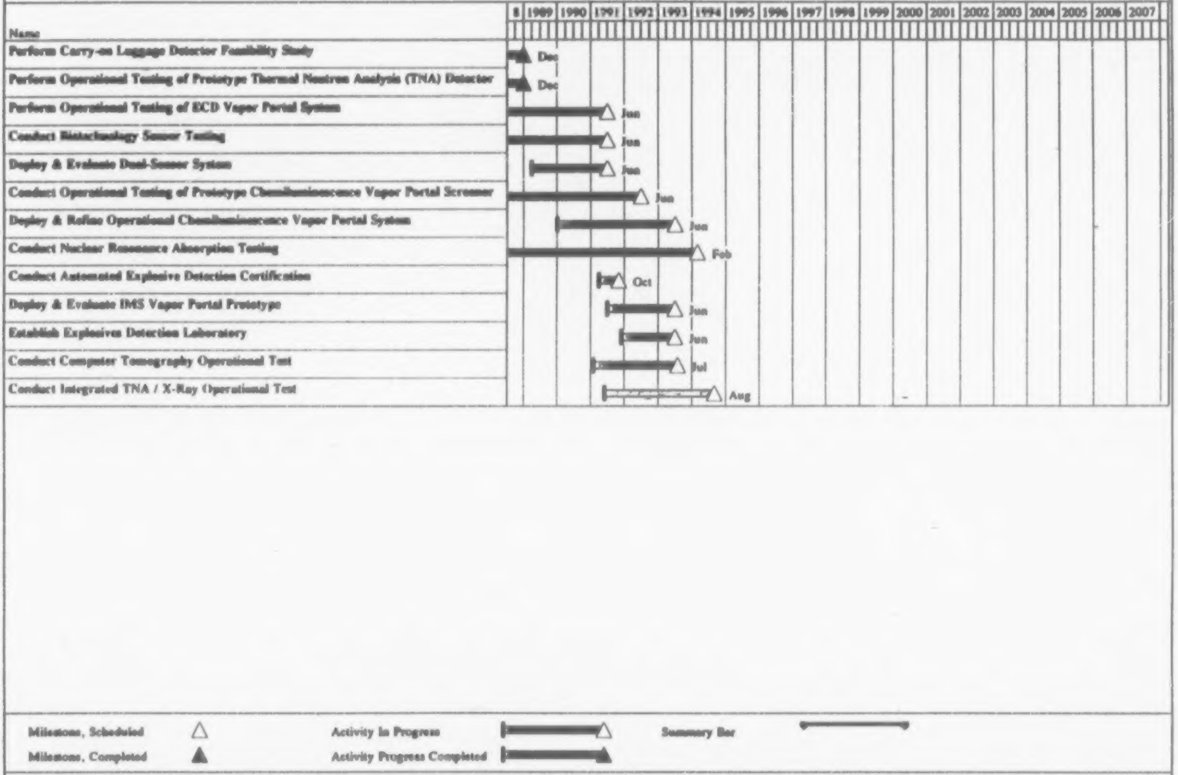
International Aircraft Operator Information Sys



Landing Gear Systems Program

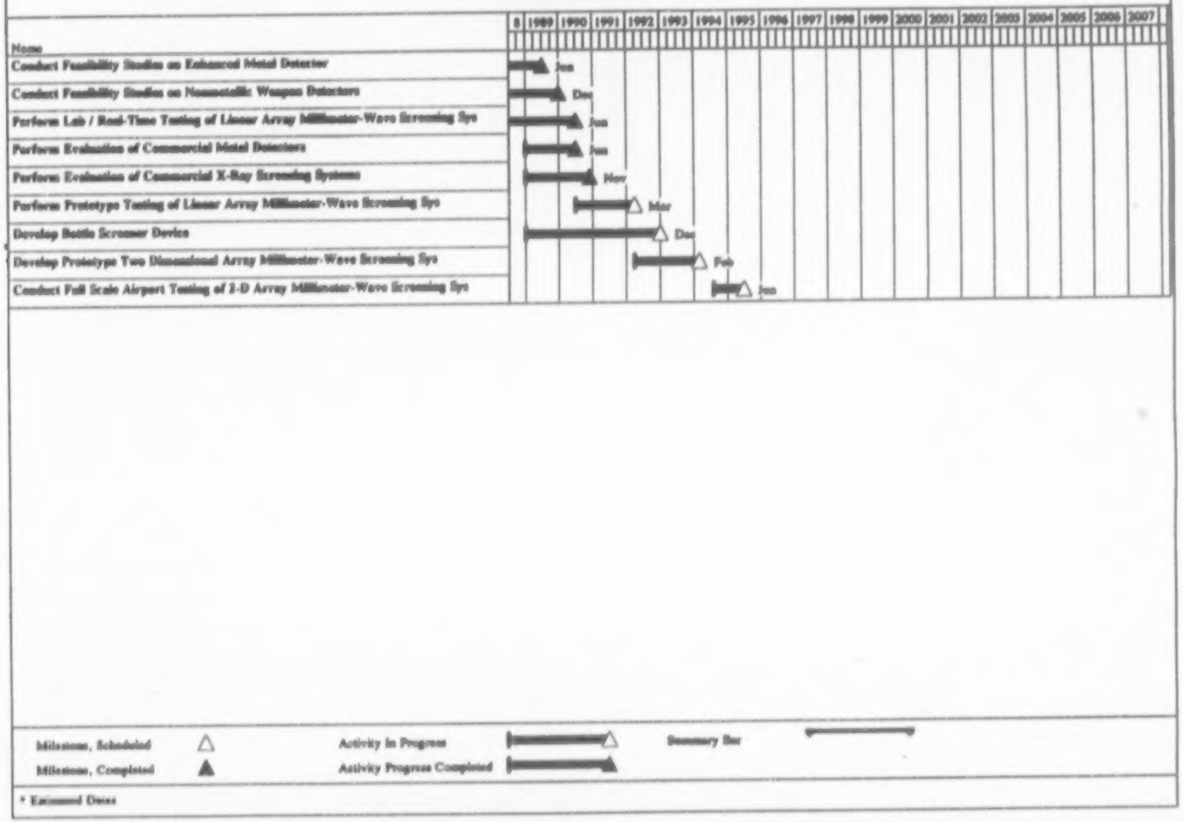


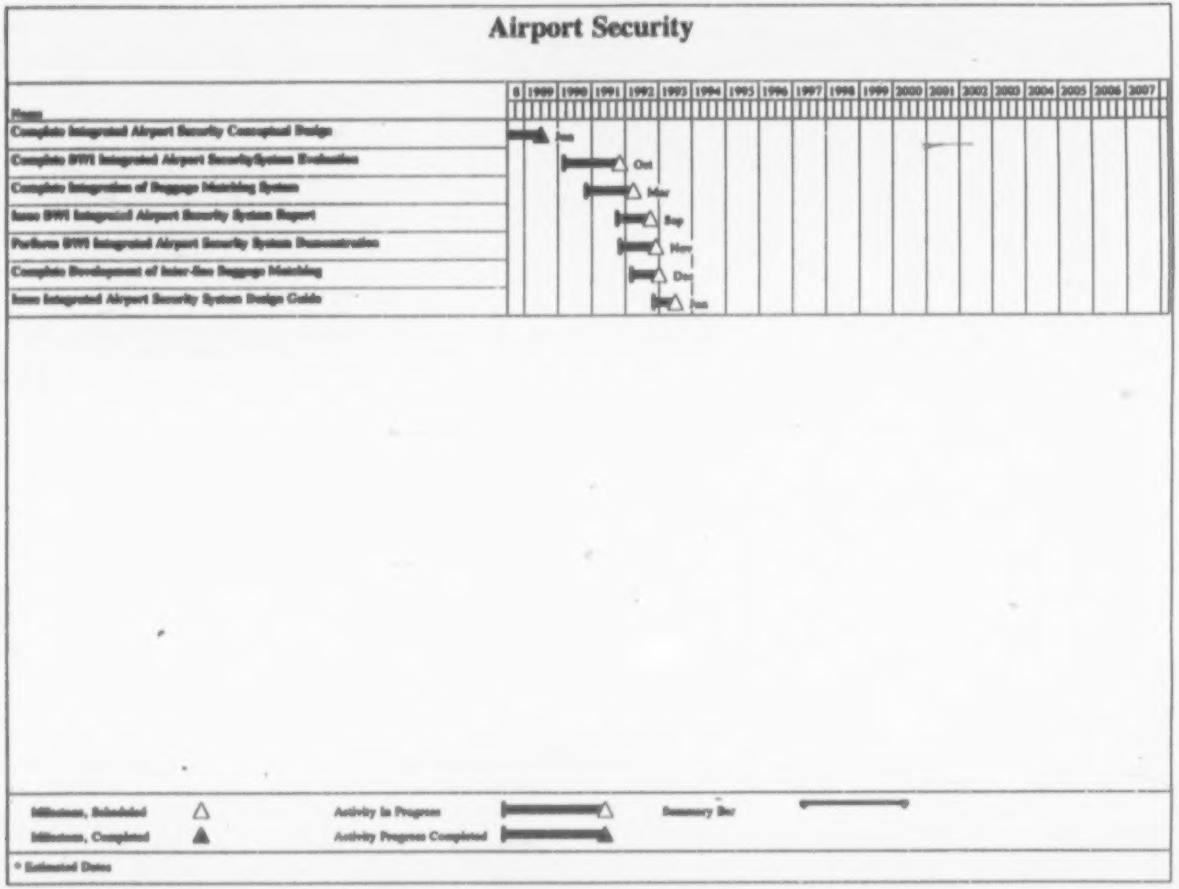
Explosives Detection



* Estimated Dates

Weapons Detection




Airport Security
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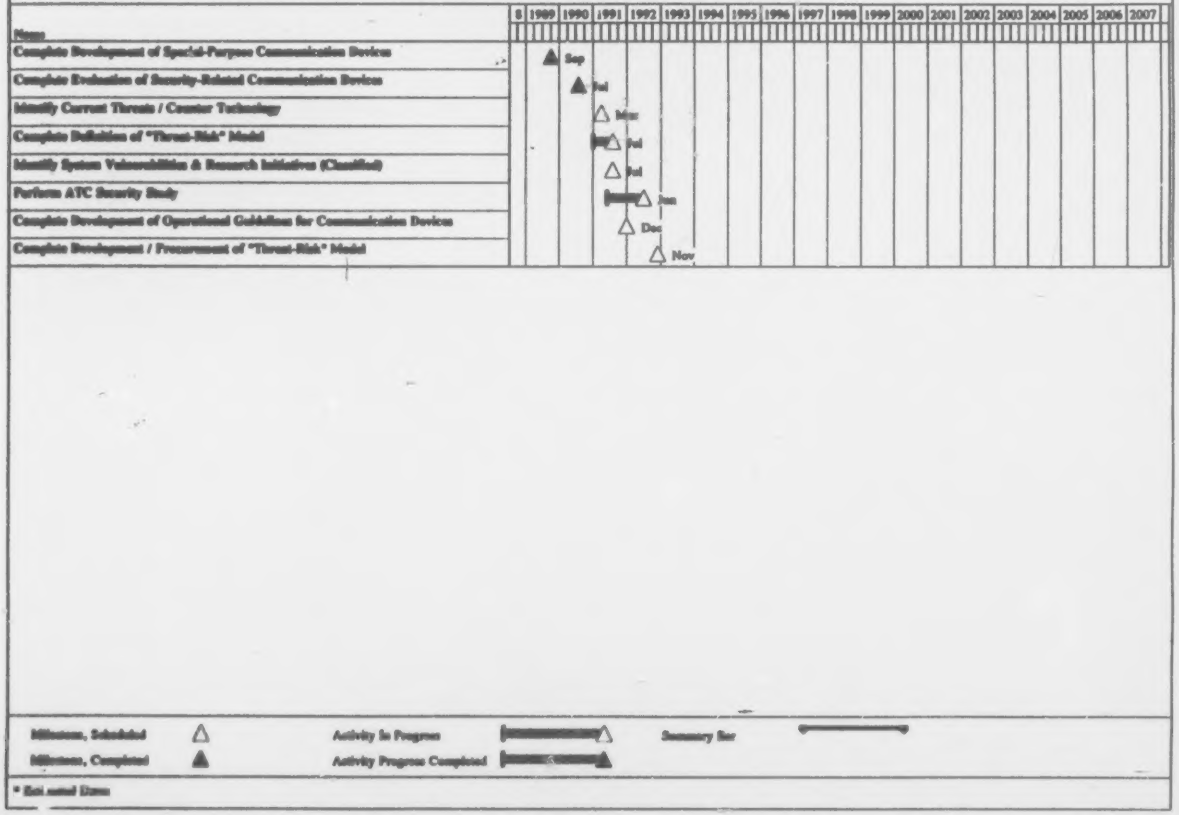
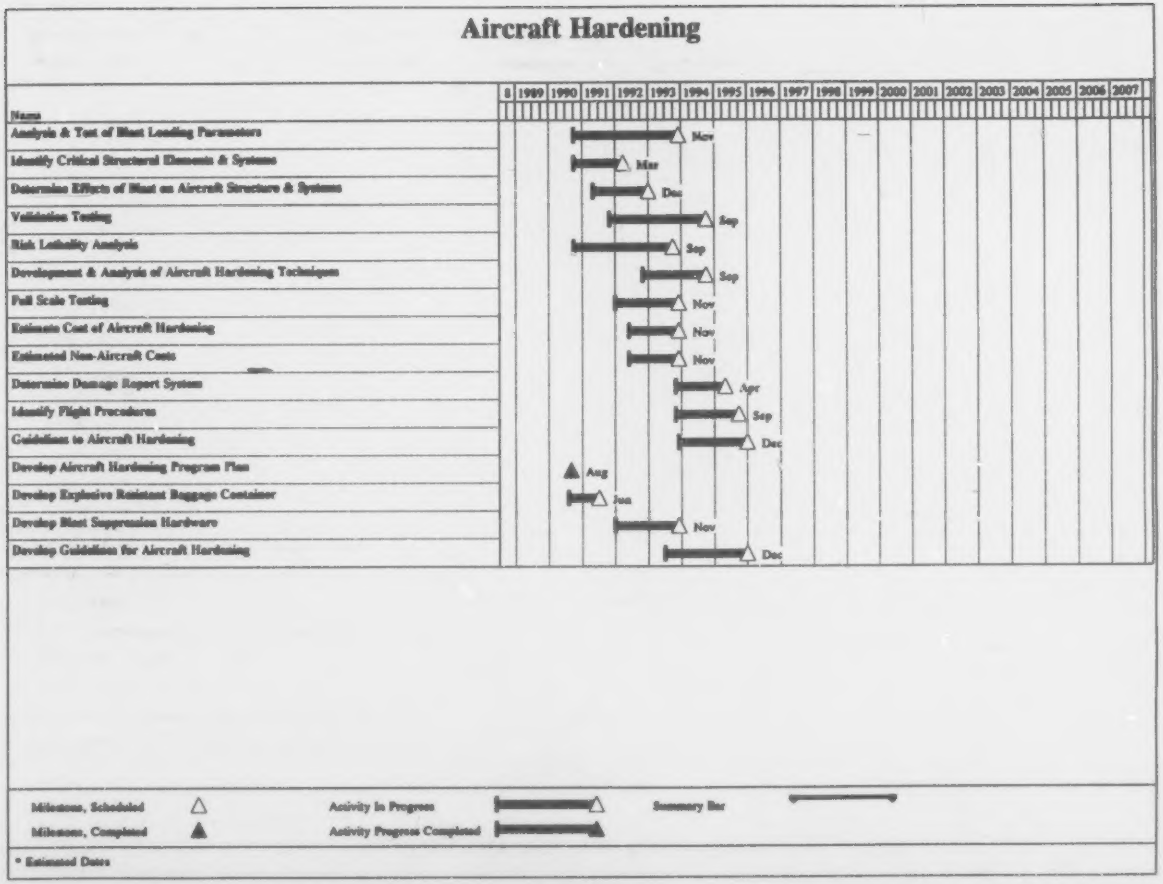
2006
2007
Complete Integrated Airport Security Conceptual Design
Jun
Complete BWI Integrated Airport Security/System Evaluation
Oct
Complete Integration of Baggage Matching System
Mar
Issue BWI Integrated Airport Security System Report
Sep
Perform BWI Integrated Airport Security System Demonstration
Nov
Complete Development of Inter-line Baggage Matching
Dec
Issue Integrated Airport Security System Design Guide
Jun
Milestone, Scheduled
Milestone, Completed
Activity In Progress
Activity Progress Completed
Summary Bar
* Estimated Dates

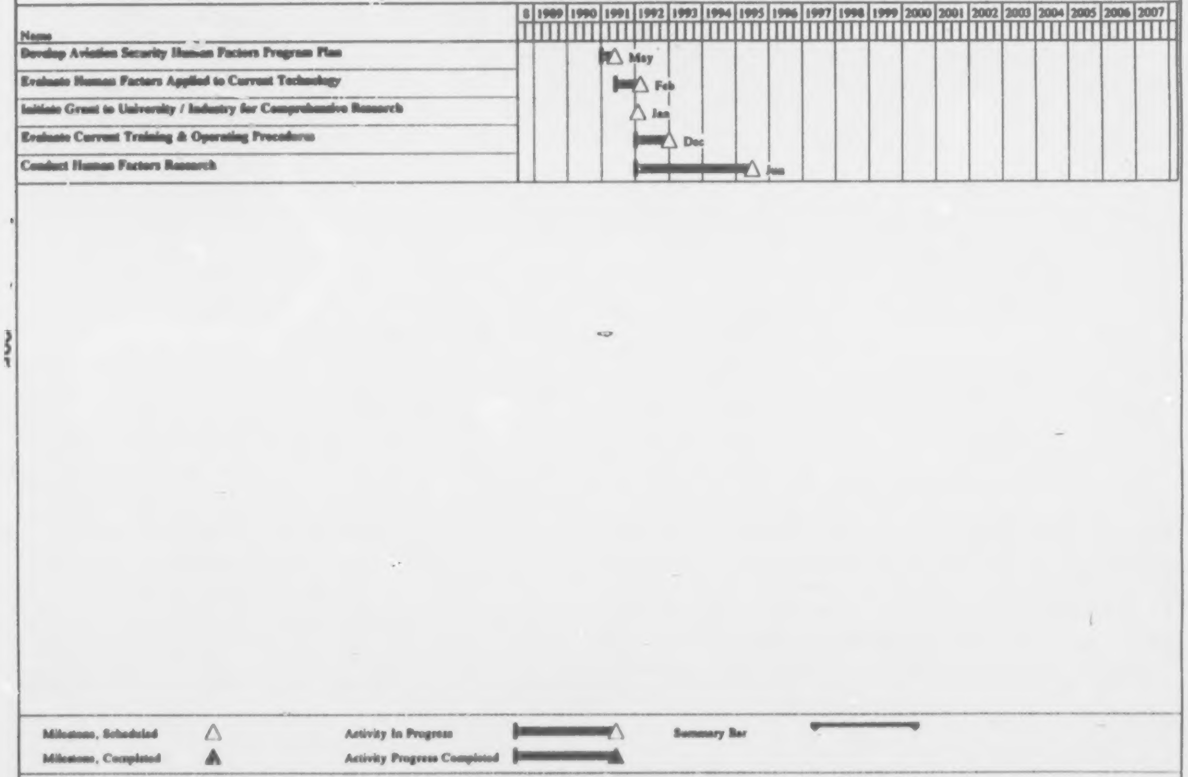
Security Systems Integration





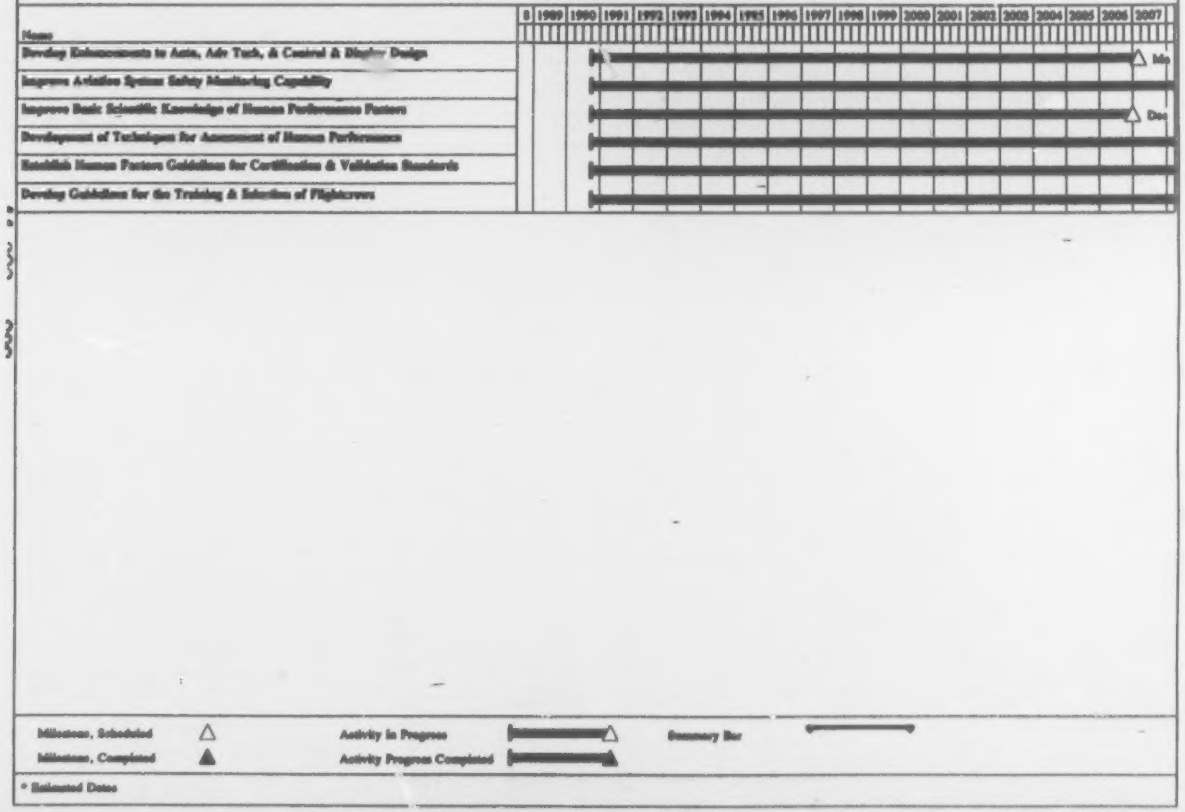
Aircraft Hardening

Aviation Security Human Factors

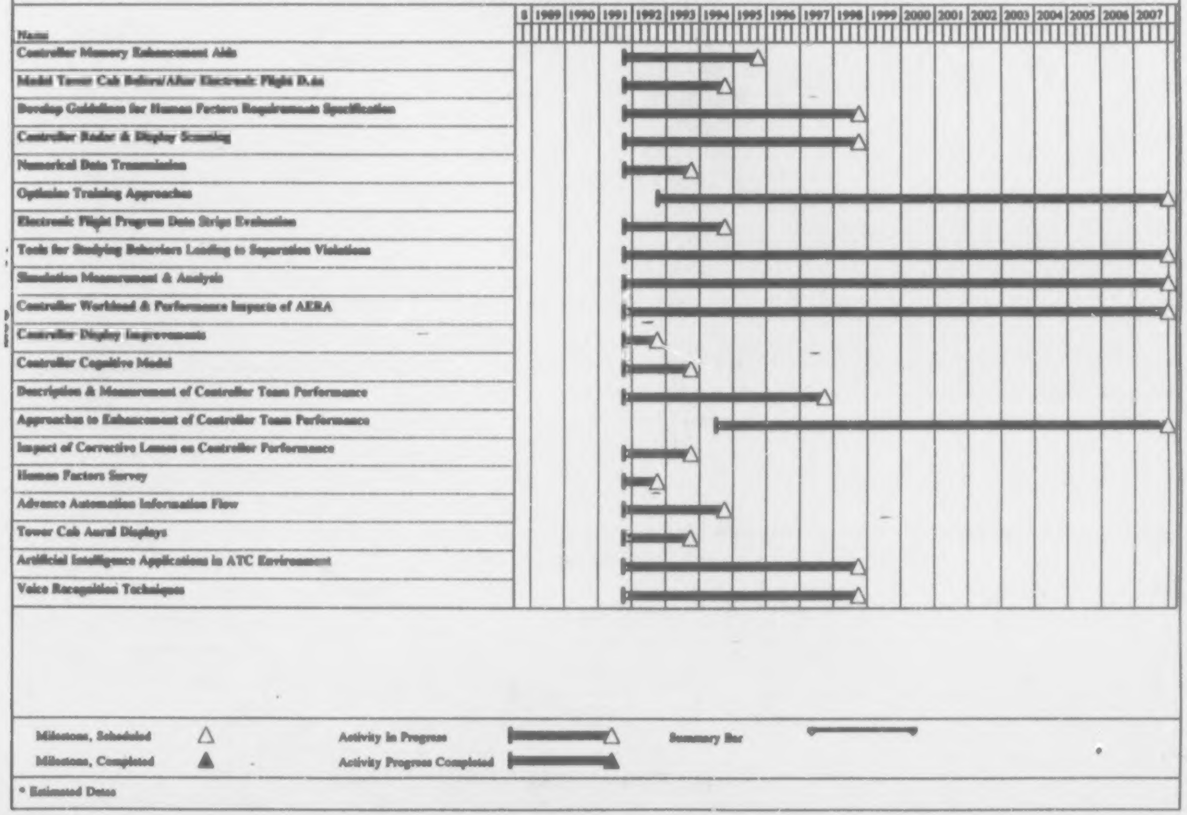


* Estimated Dates

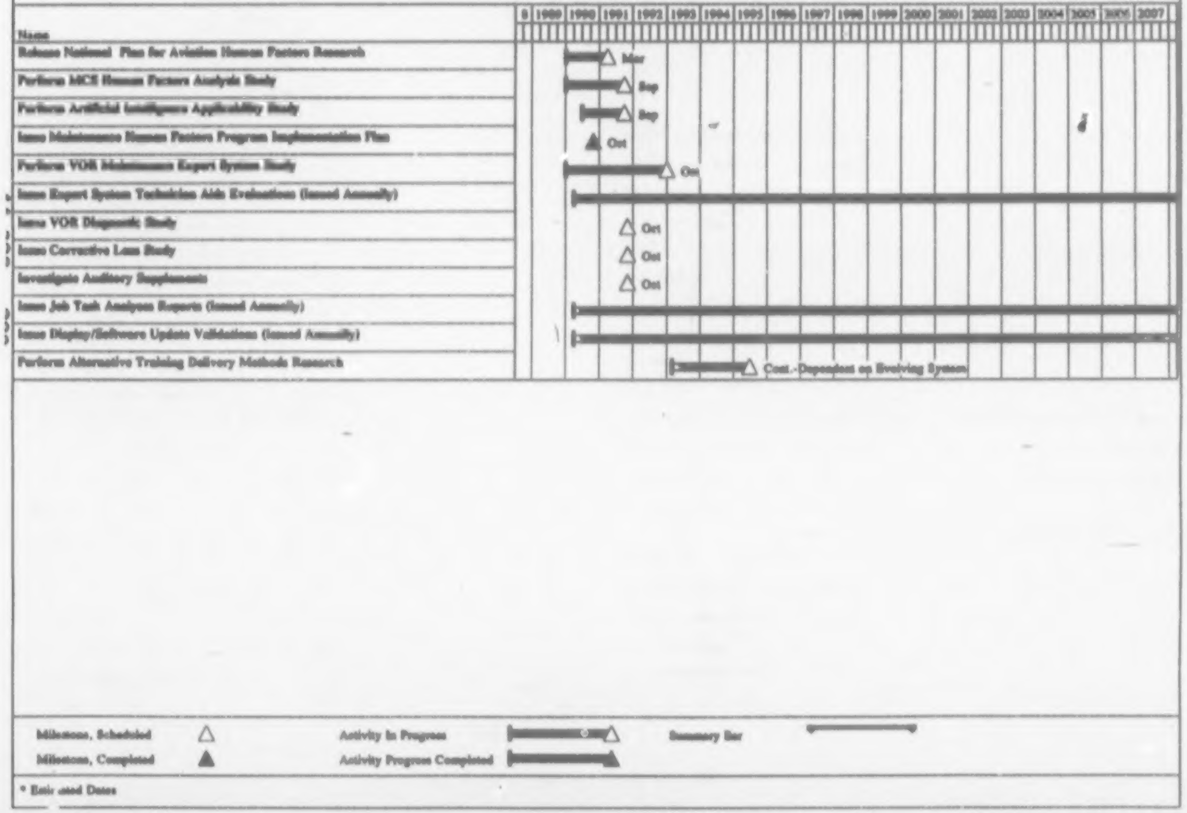
Flightdeck Human Factors



Controller Human Factors

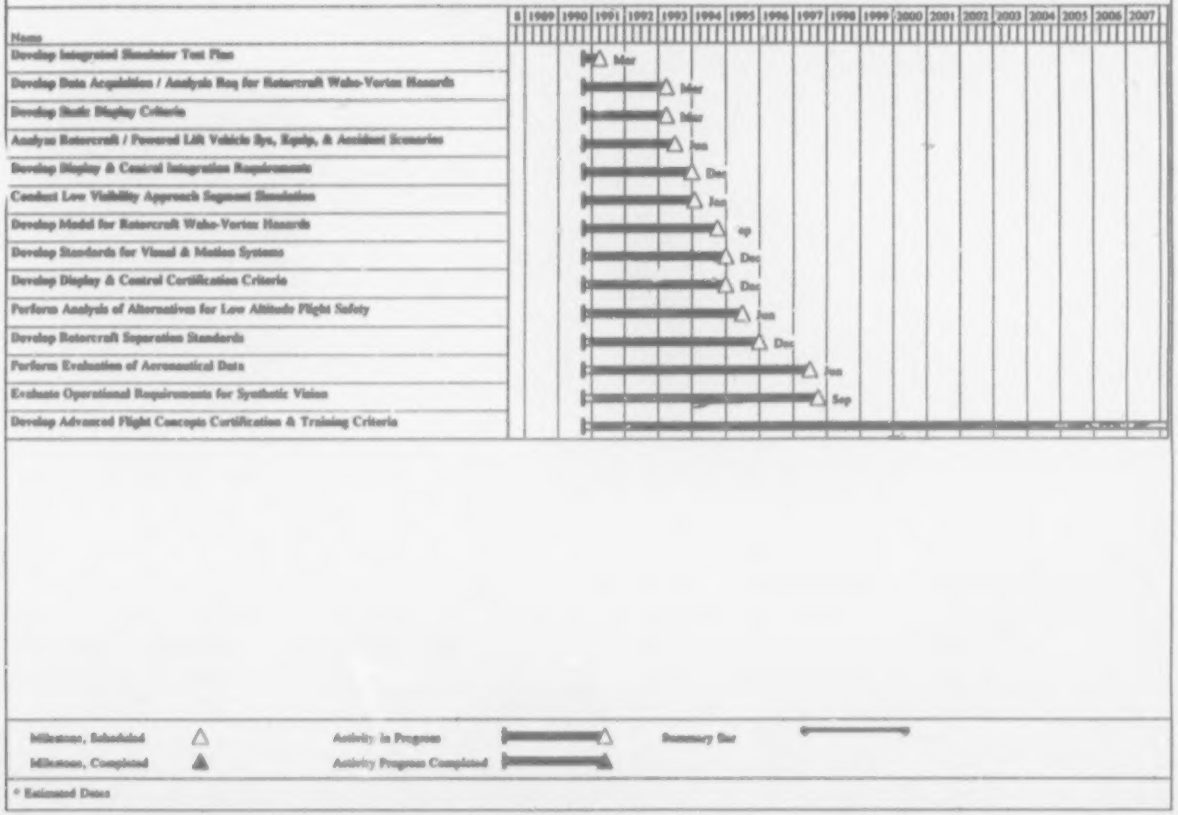


Airway Facilities Maintenance Human Factors

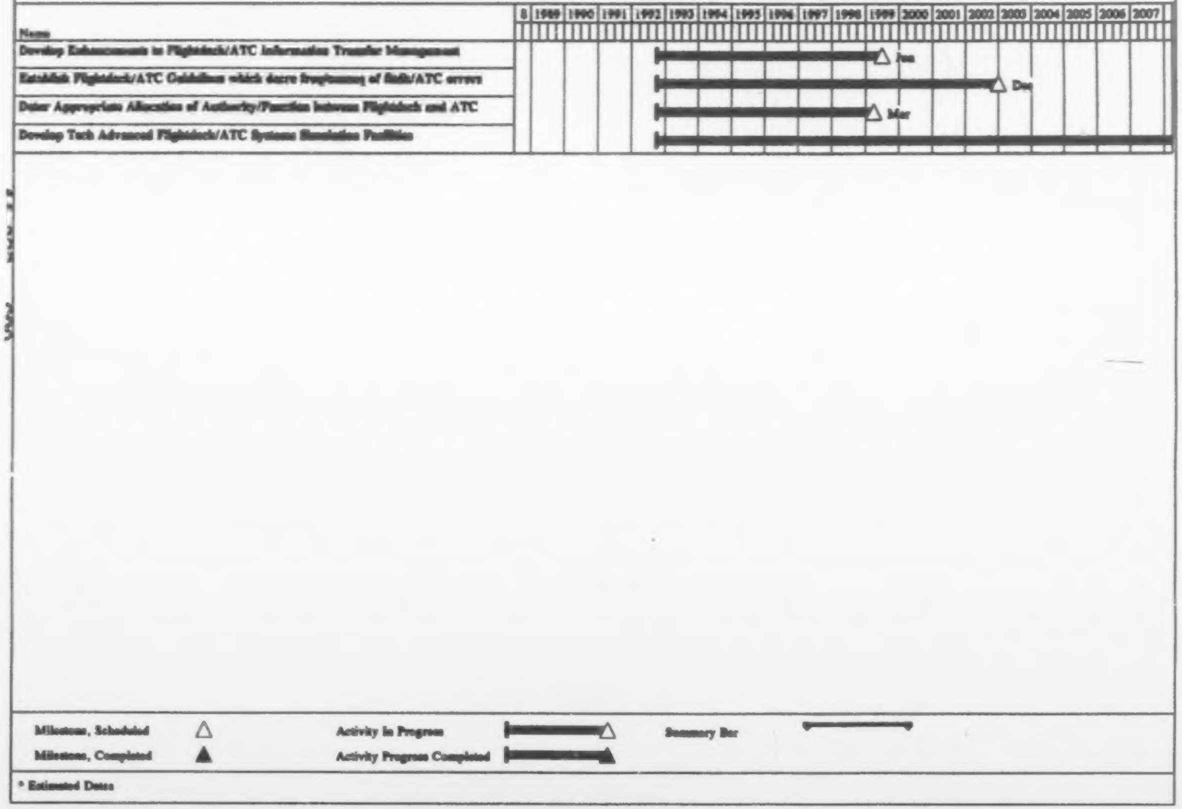


* Estimated Dates

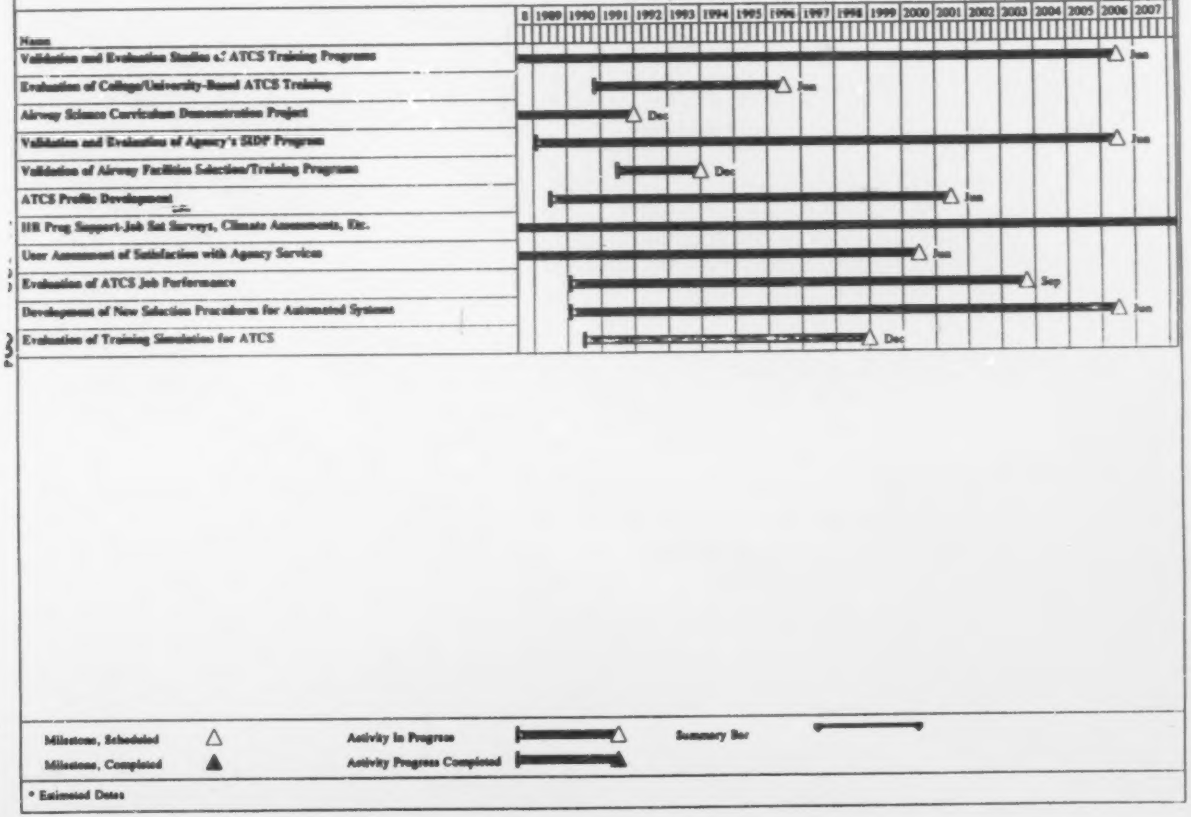
Vertical Flight Performance Analysis



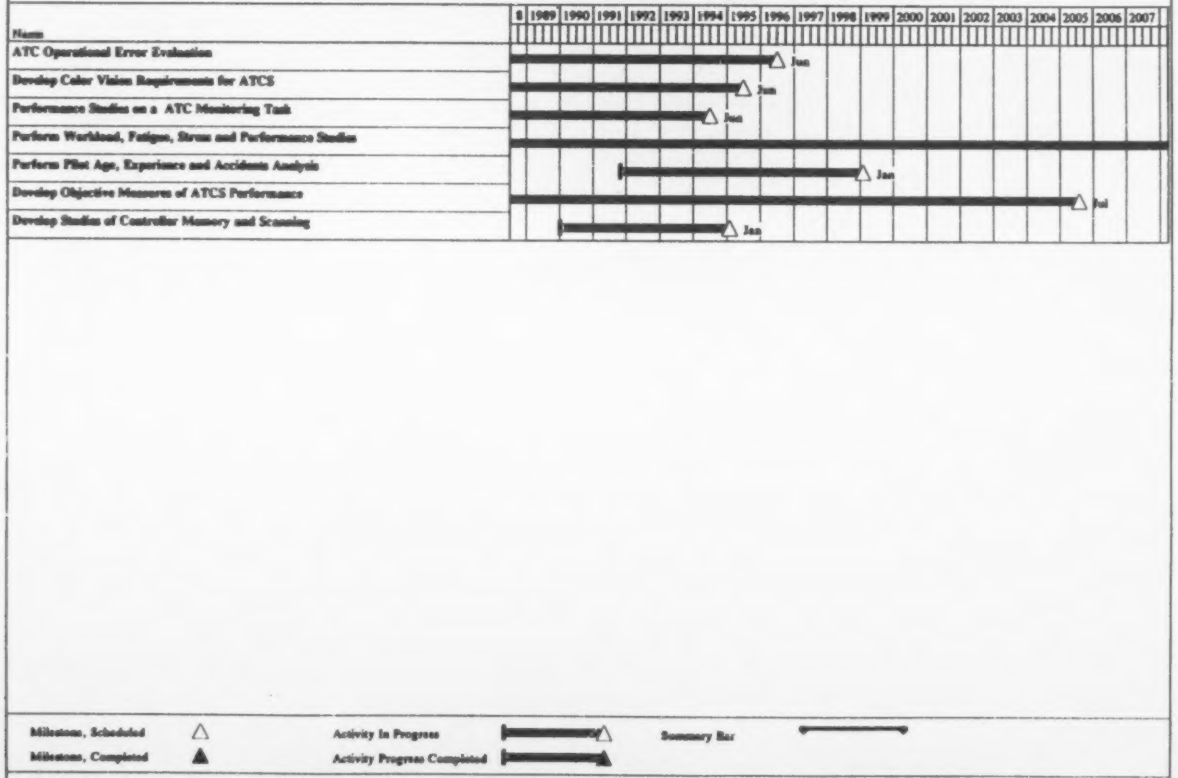
Flightdesk/ATC System Integration



Work Force Selection, Training & Efficiency Res



Psychophysiological Factors in Performance Res



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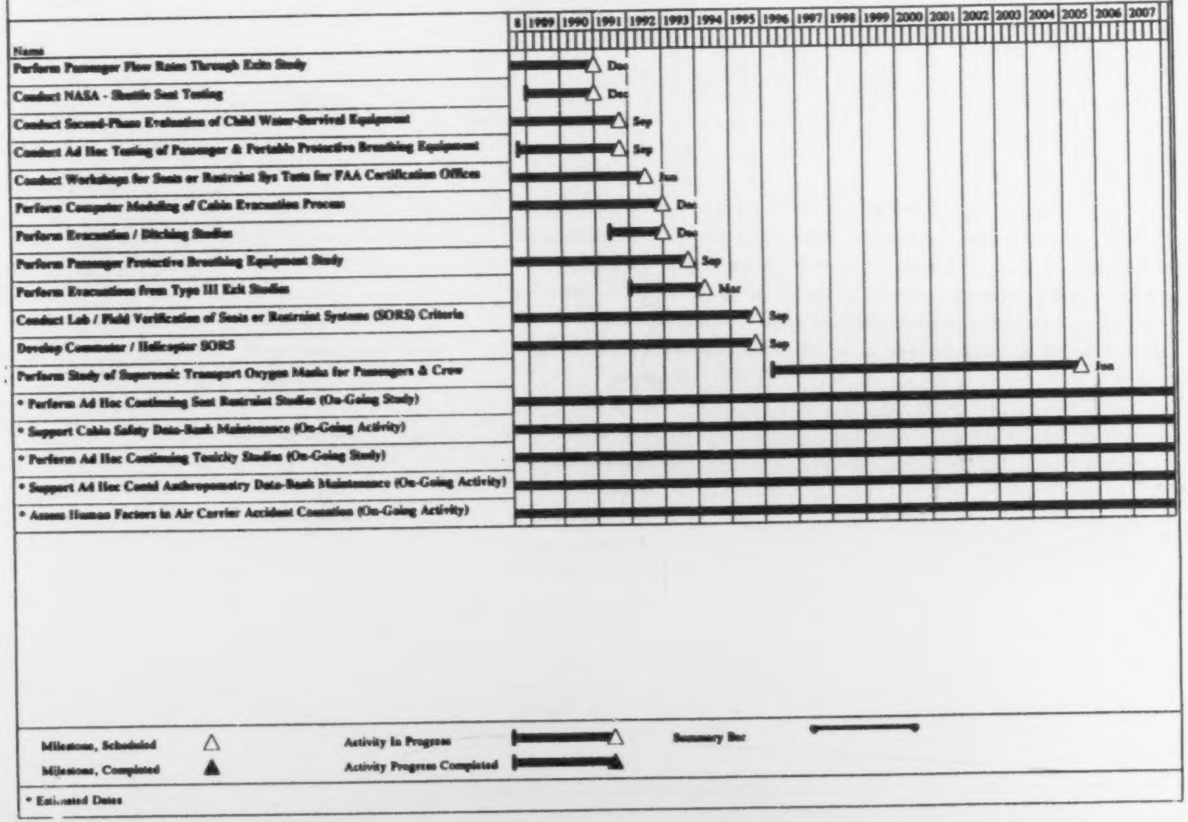
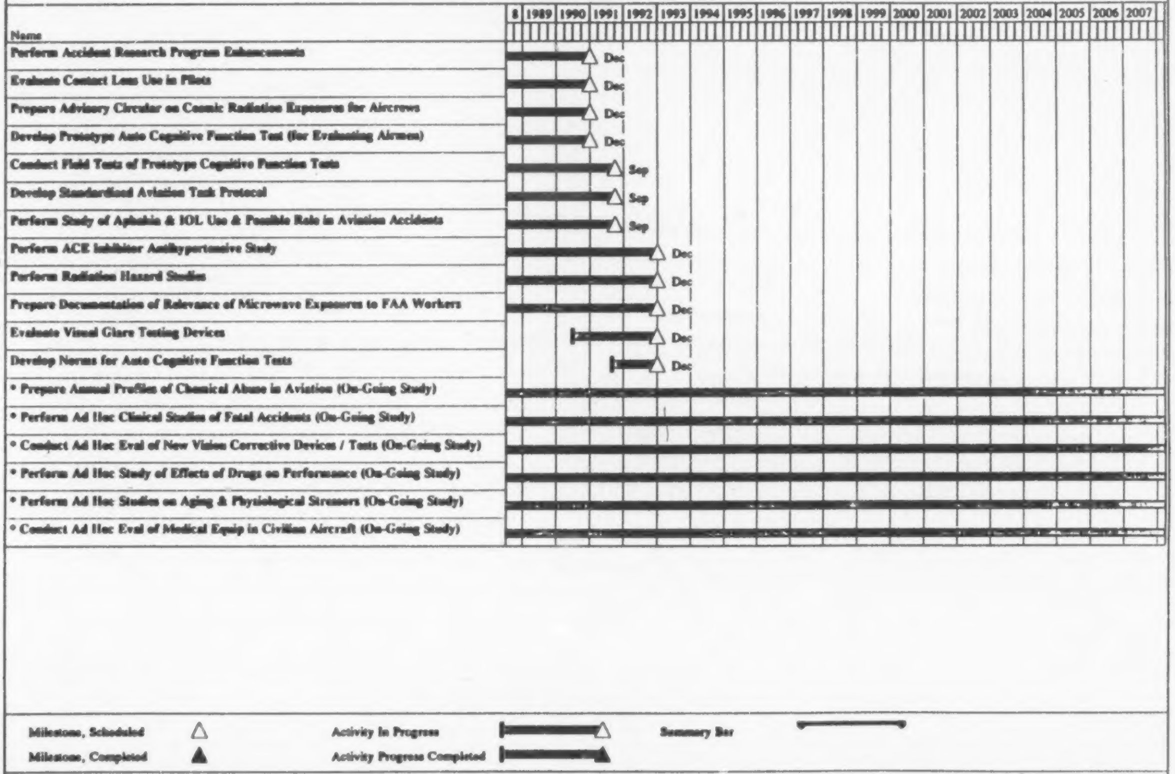
Protection & Survival

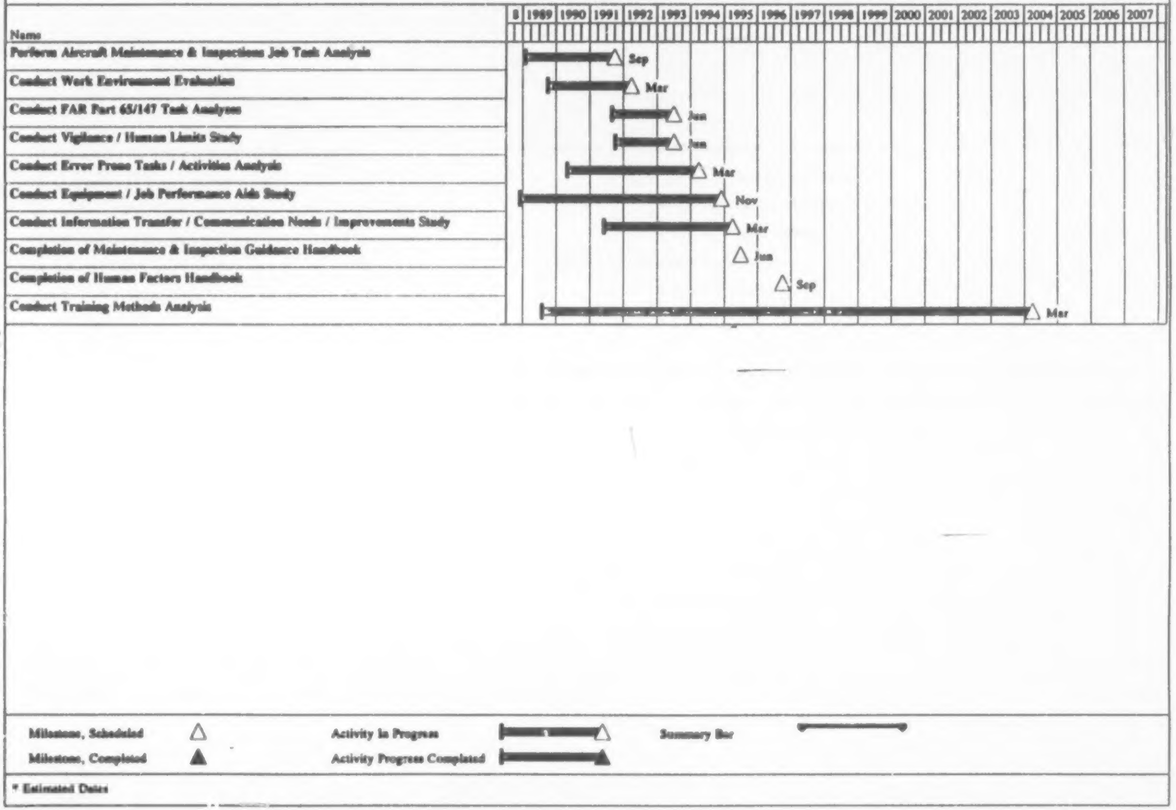


Aeromedical Program Support

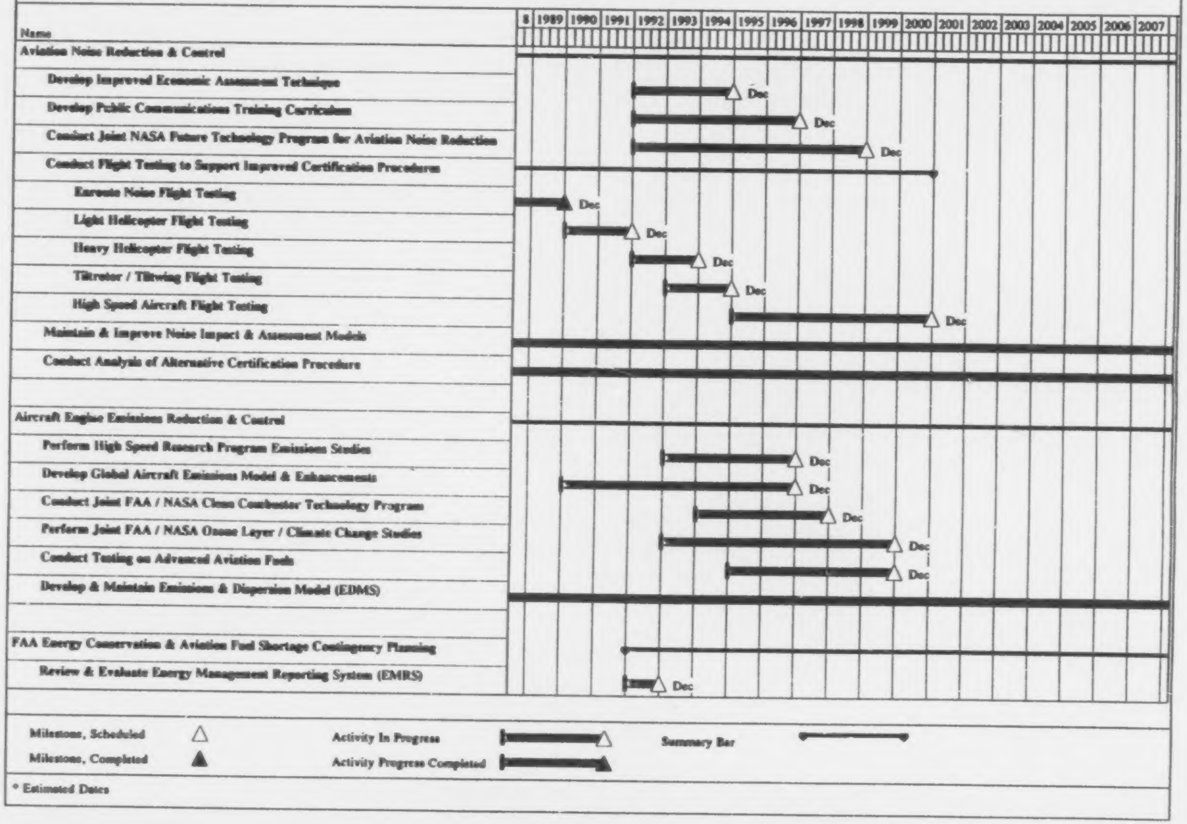


* Estimated Dates

Aircraft Maintenance & Inspection Human Factors



Environment & Energy



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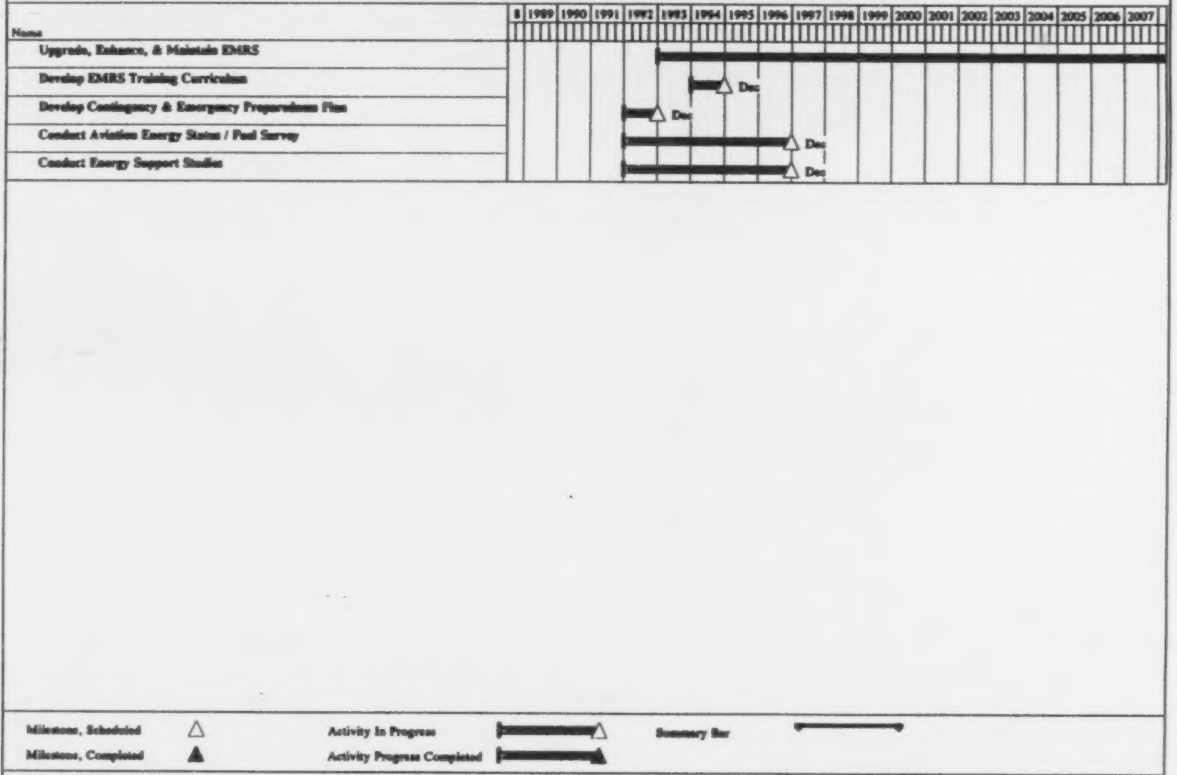
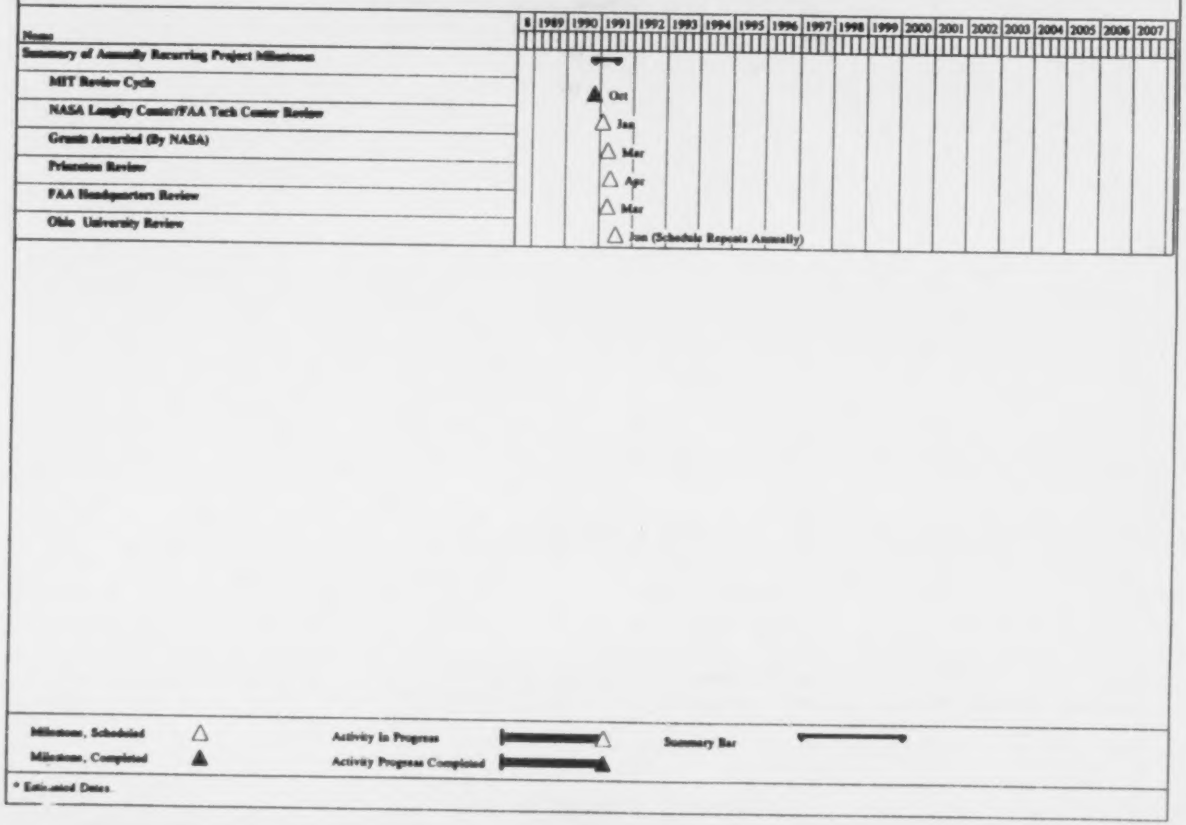
Environment & Energy



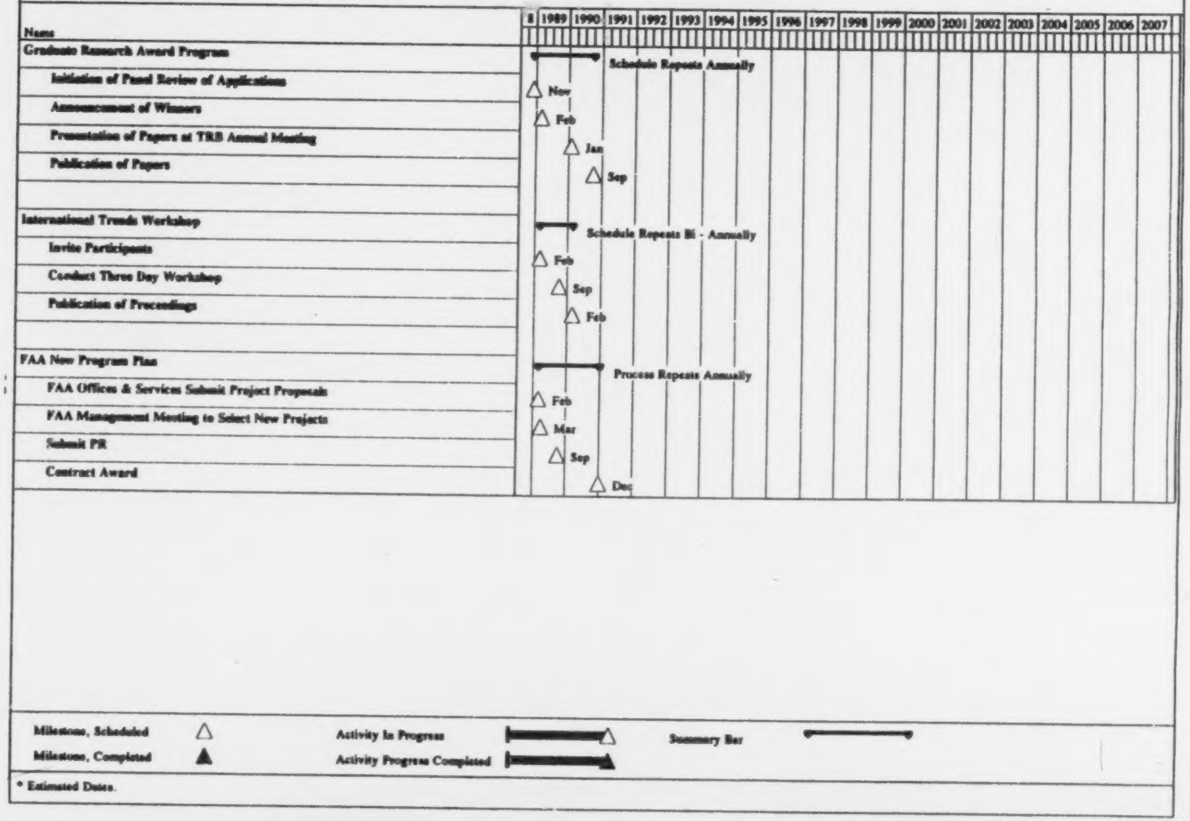
* Estimated Dates

FAA/NASA Joint University Program

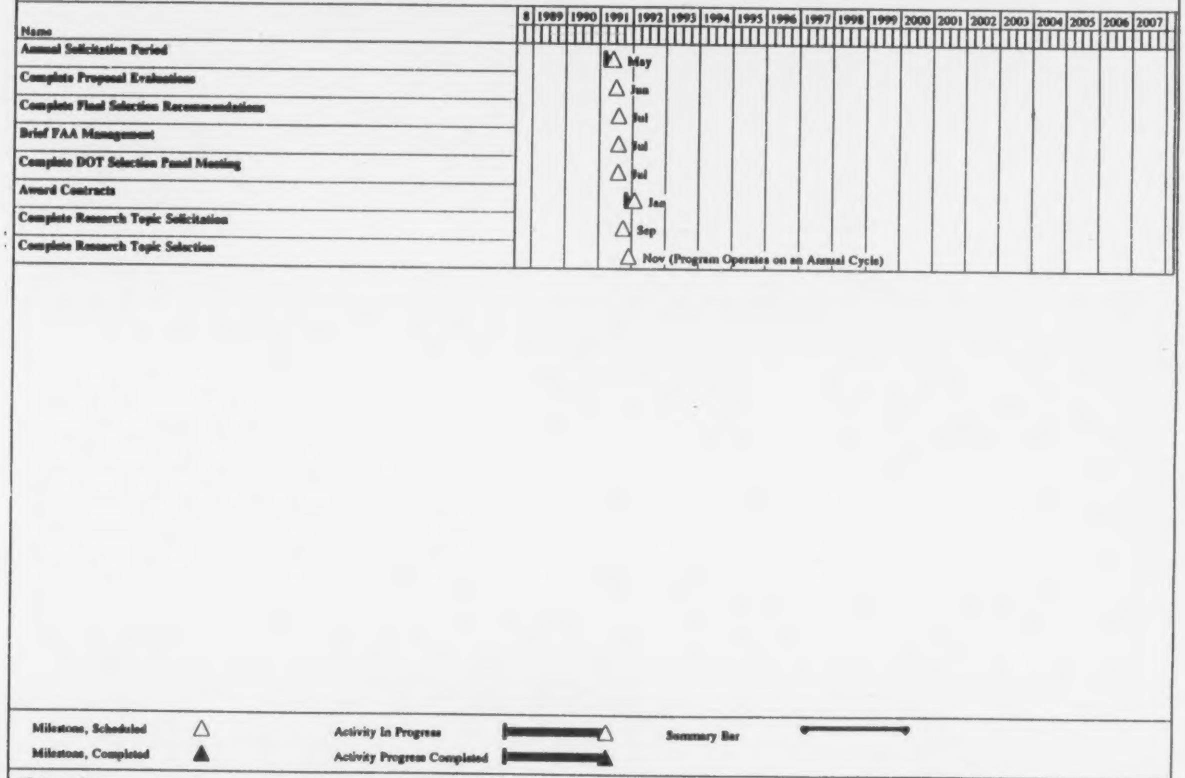


* Estimated Dates

Transportation Research Board

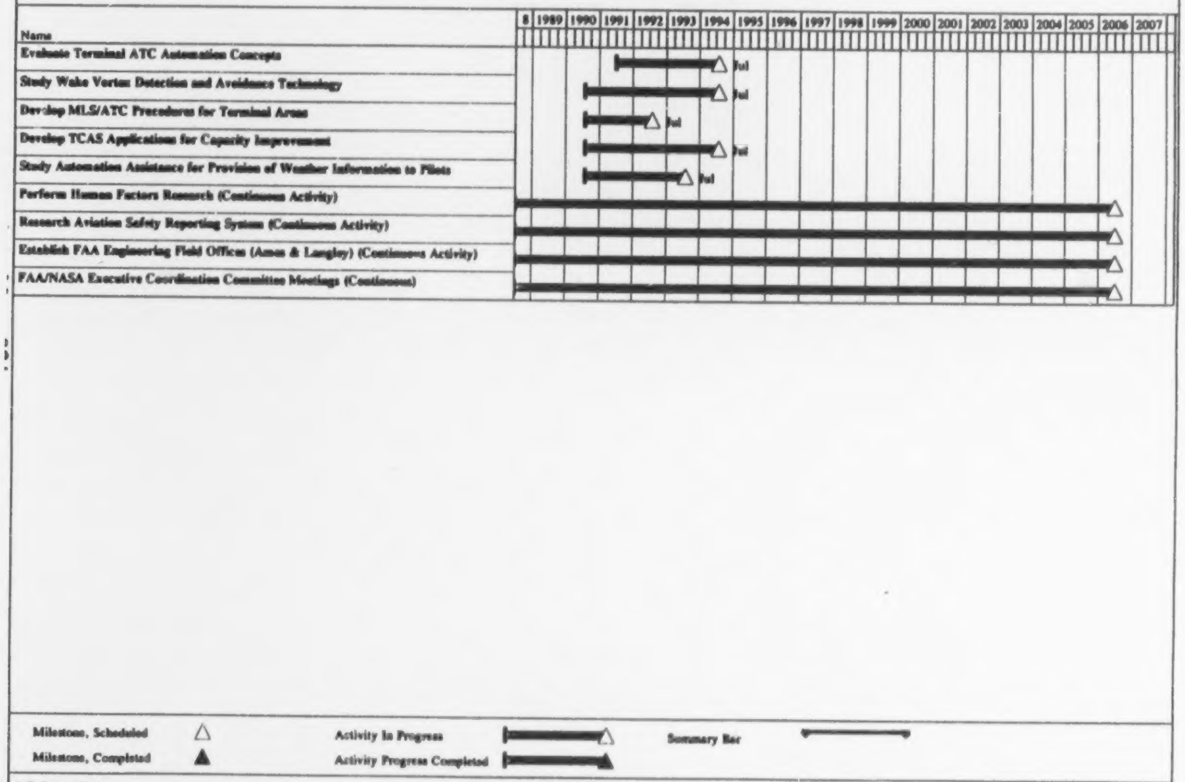


Small Business Innovative Research (SBIR) Program



* Estimated Dates.

FAA/NASA Cooperative Programs



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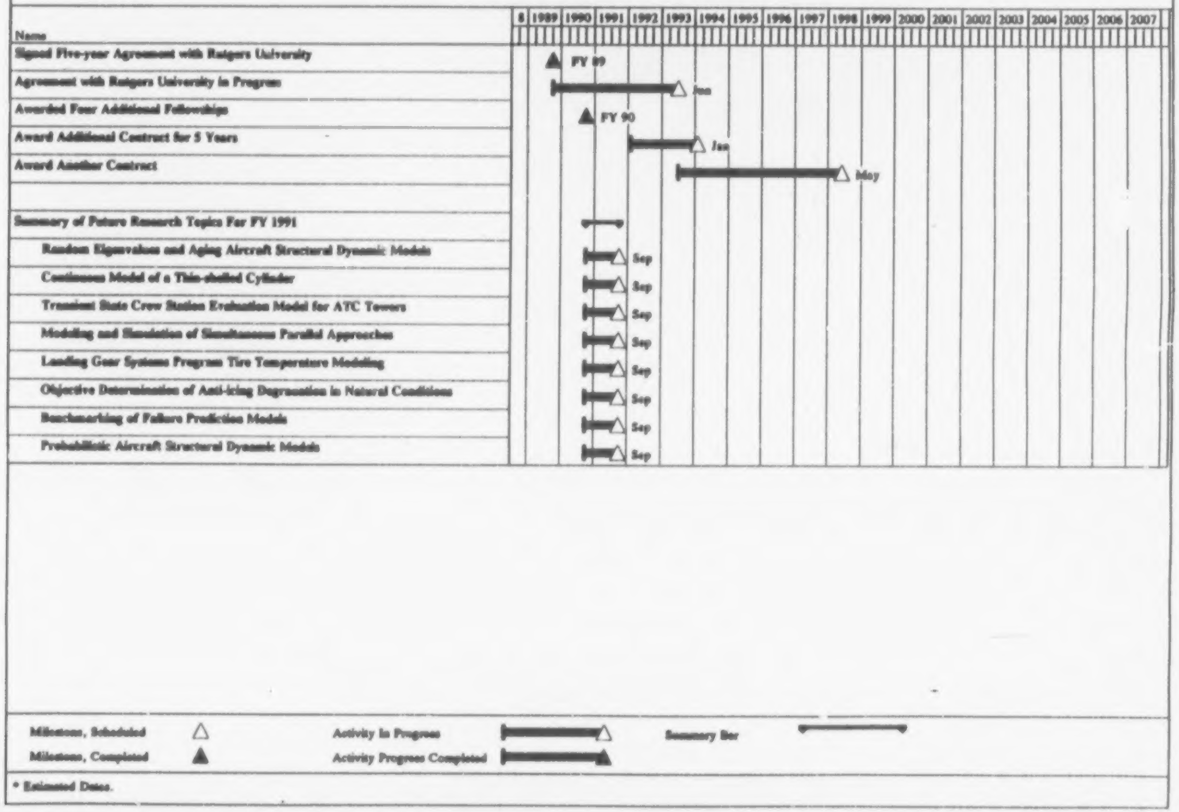
University Fellowship Research Program



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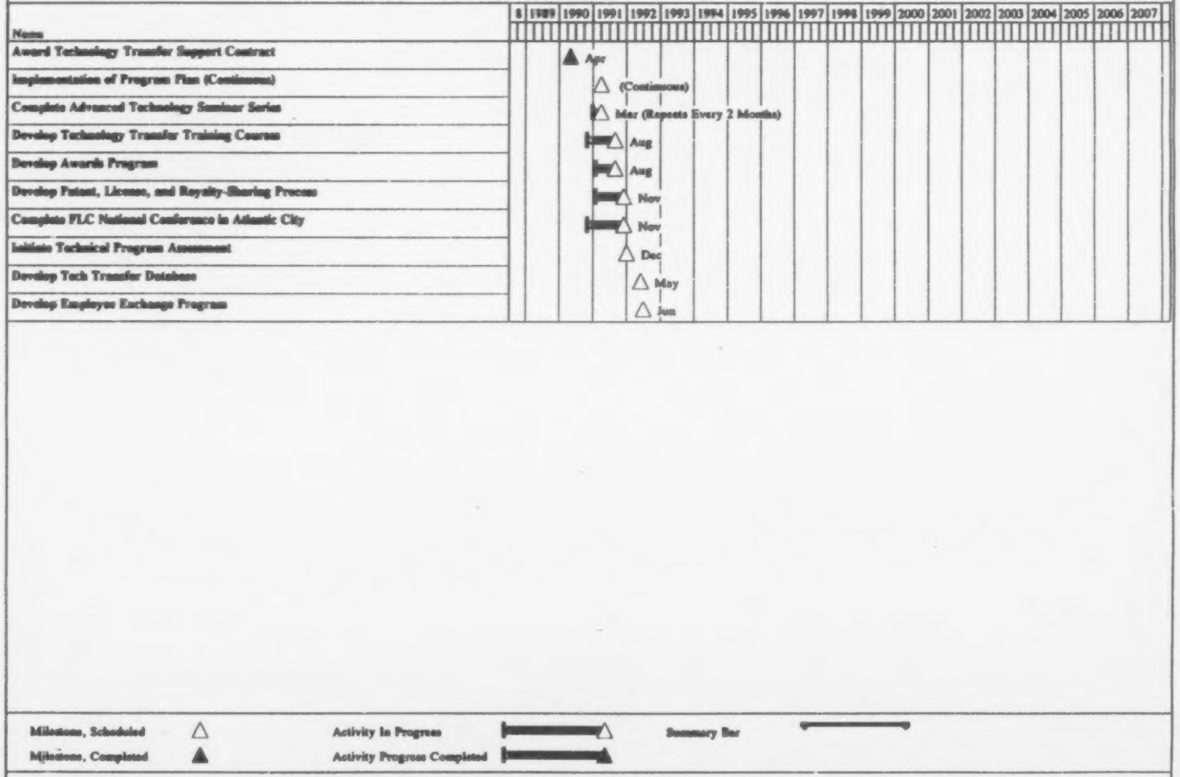
Technology Transfer



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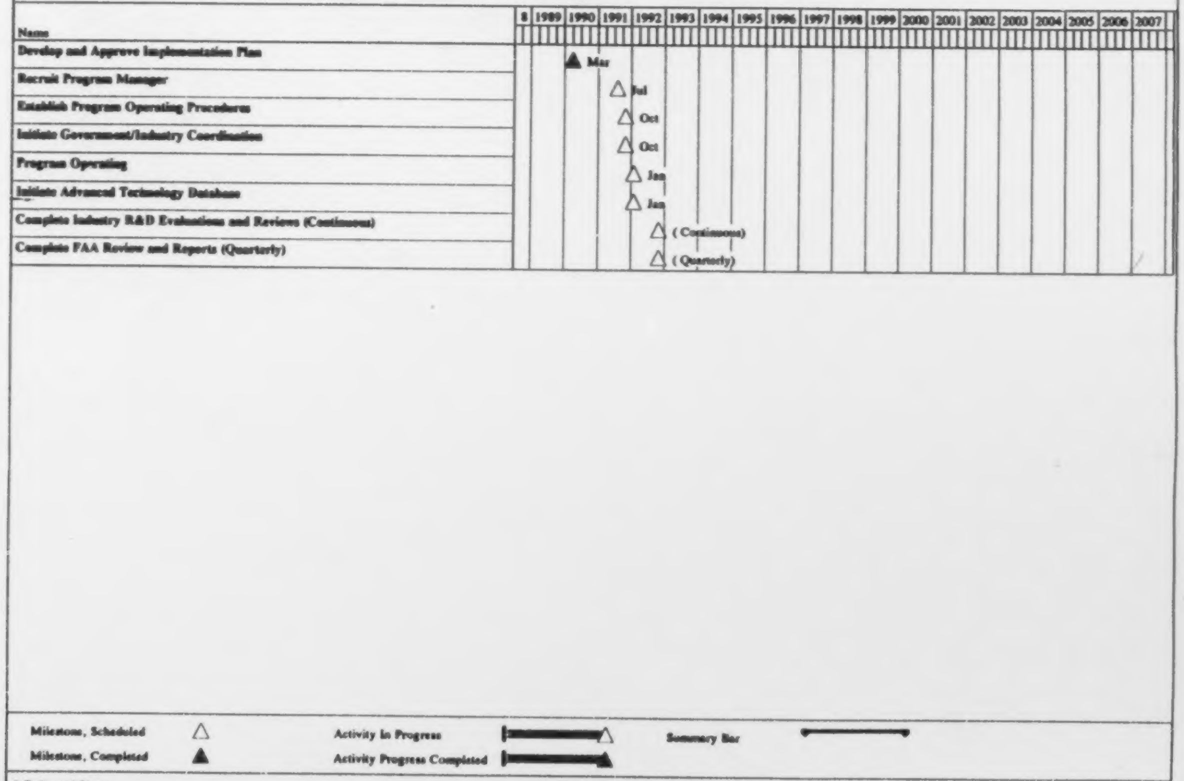
Independent Research and Development Program



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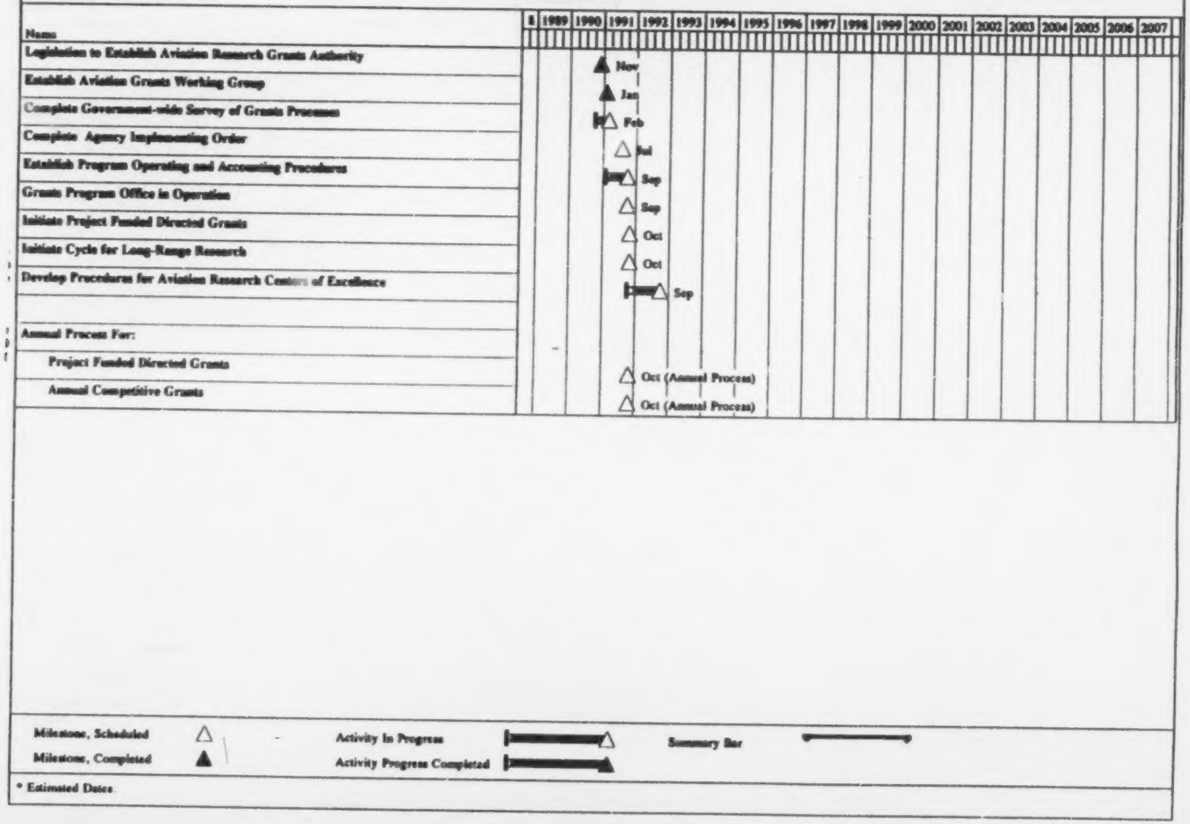
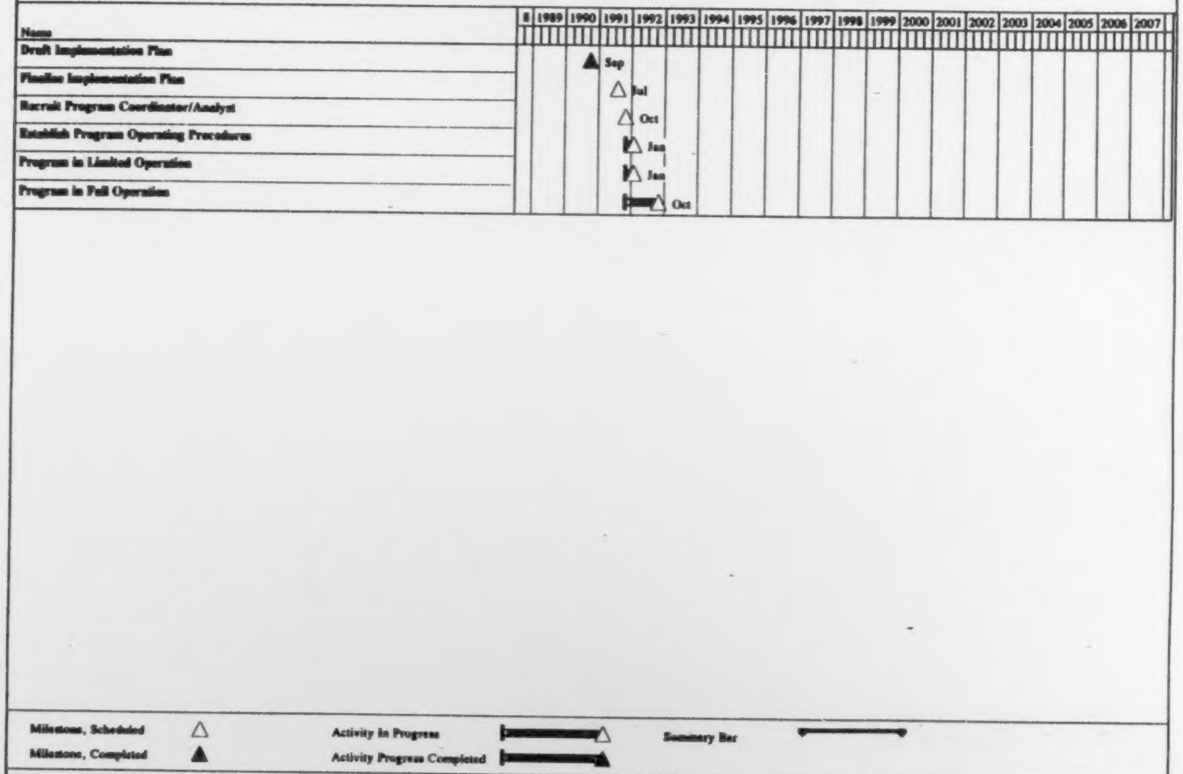
Aviation Research Grant Program



* Estimated Dates

Innovation Dev. and Engineering Appl. (IDEA)



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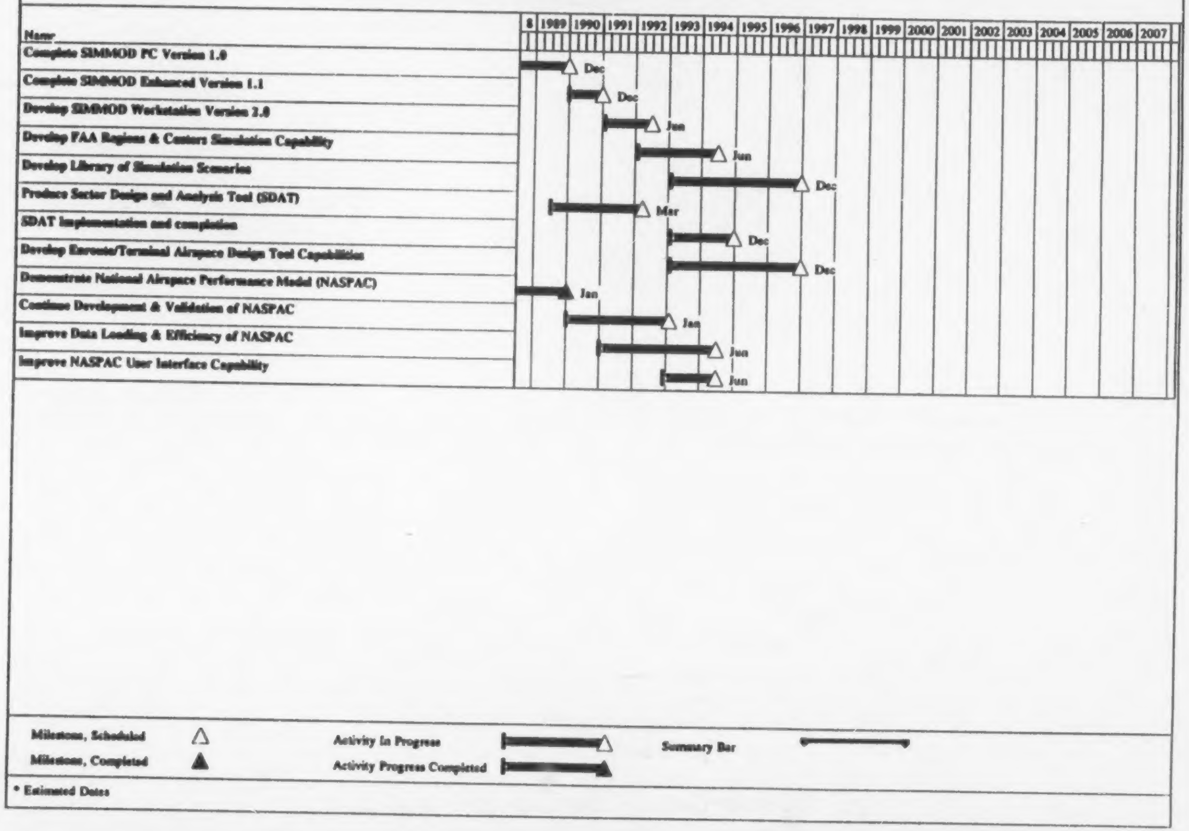
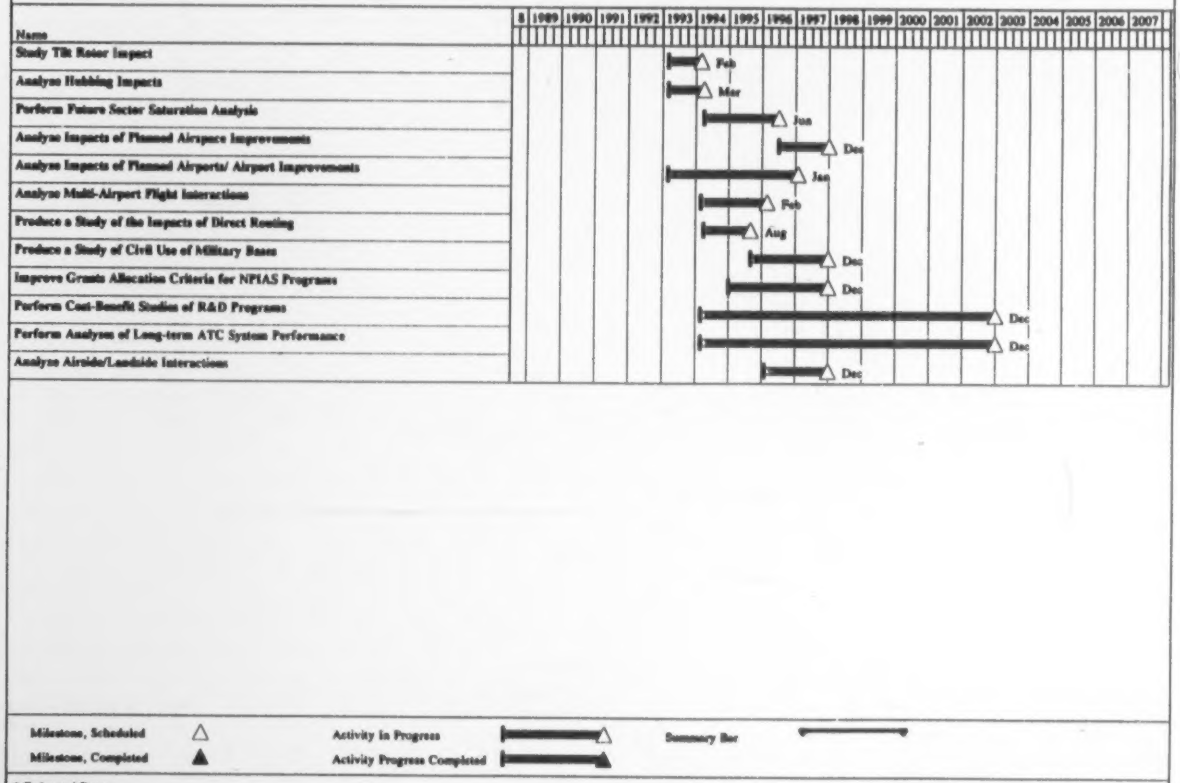
Air Traffic Models & Evaluation Tools



Airport and Airspace Impact Assessments



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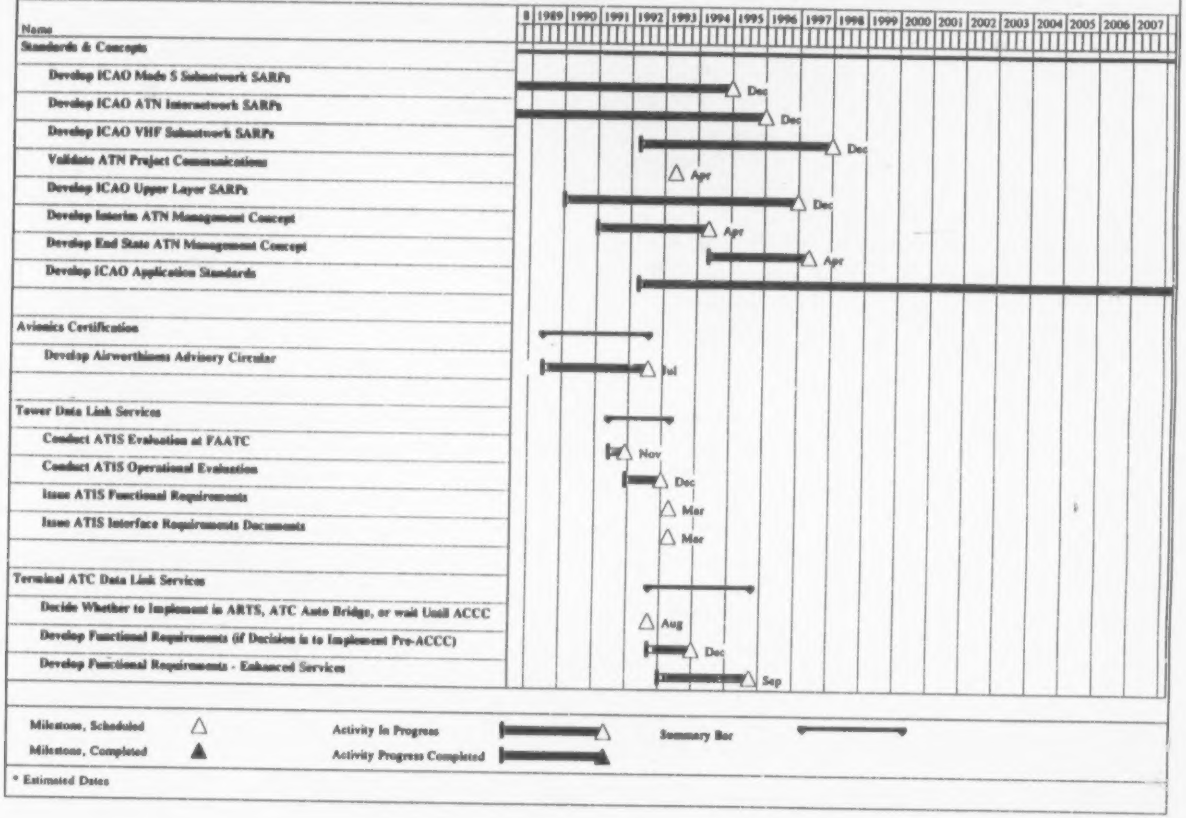
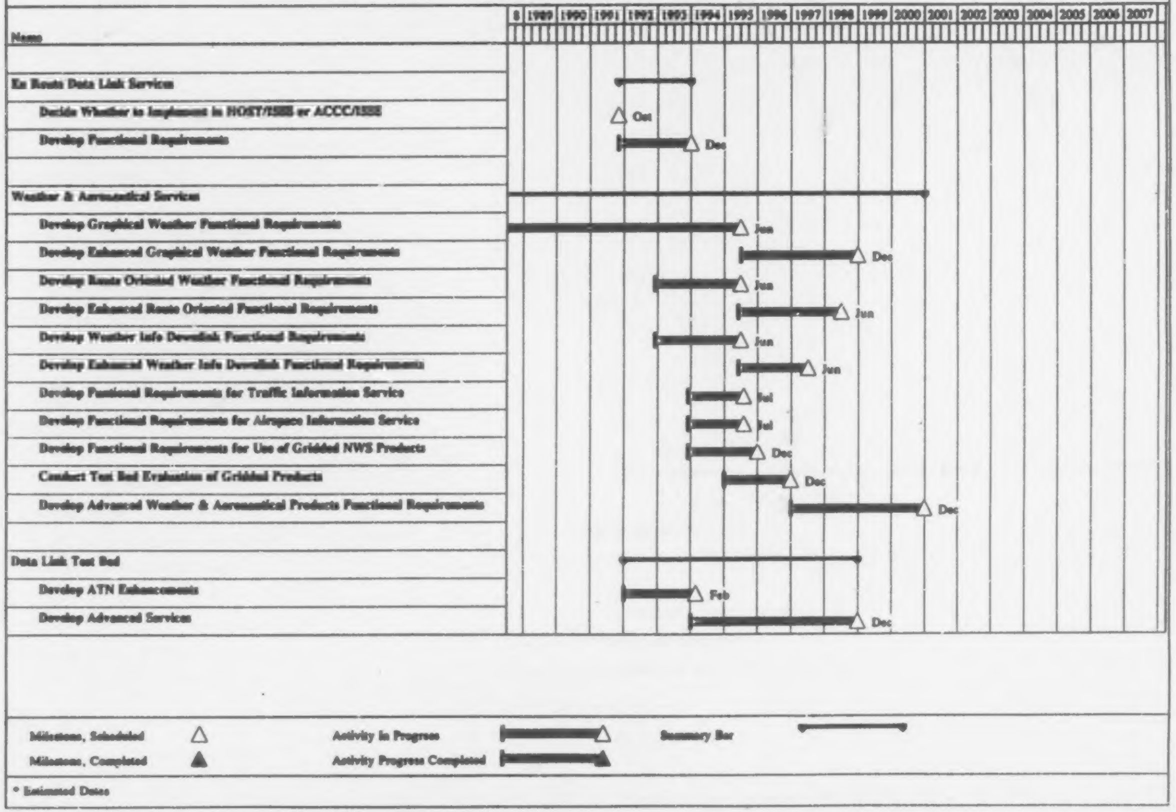
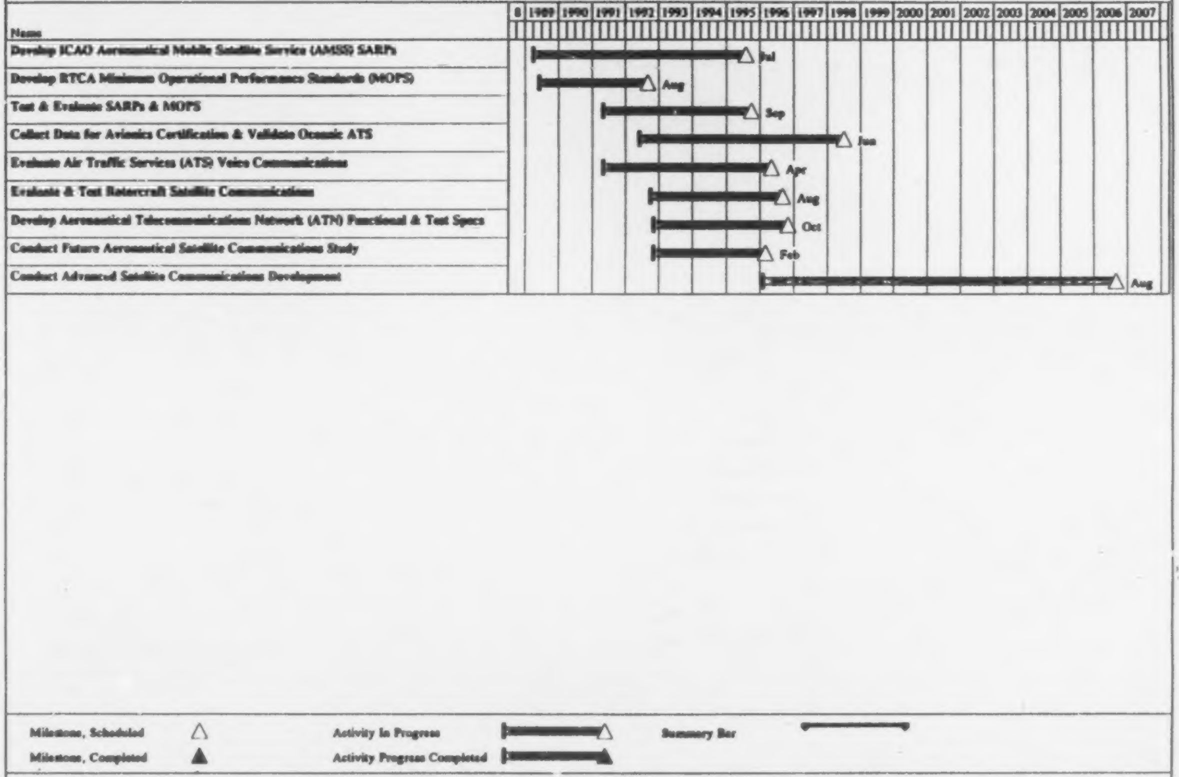
Aeronautical Data Link - Comm & Applications



Aeronautical Data Link - Comm & Applications



Satellite Communications Program



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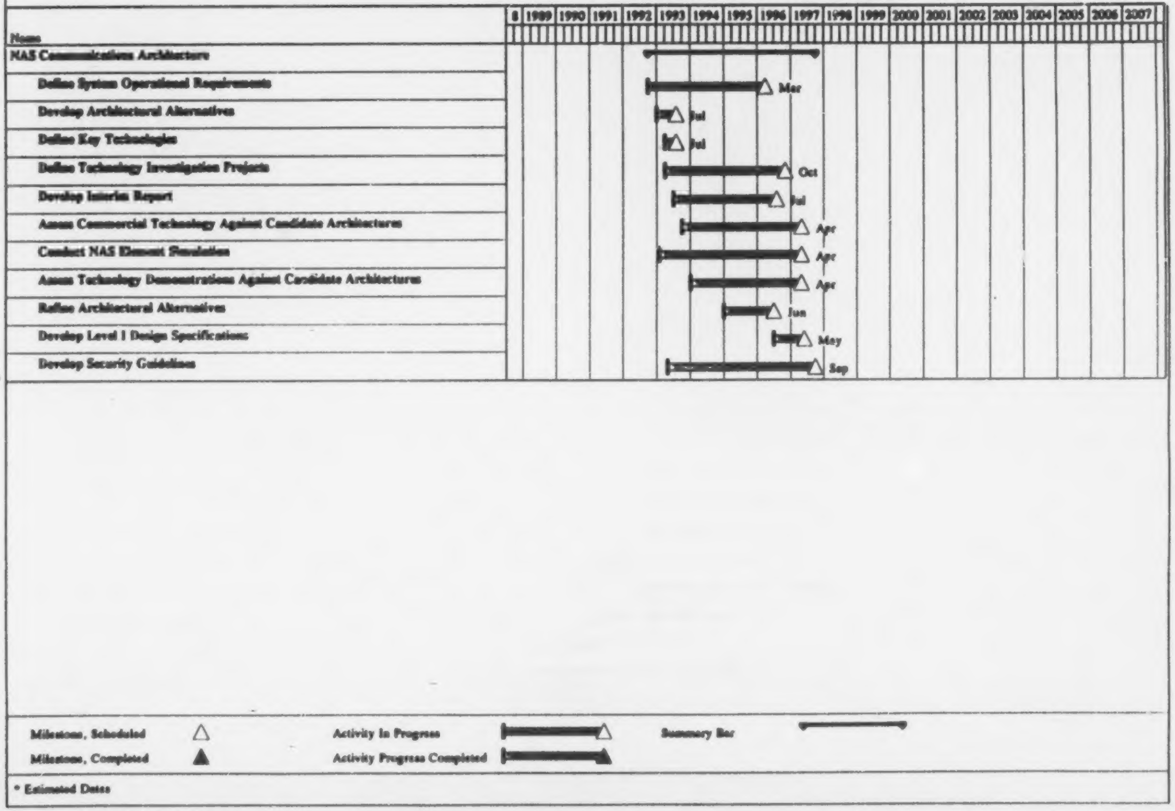
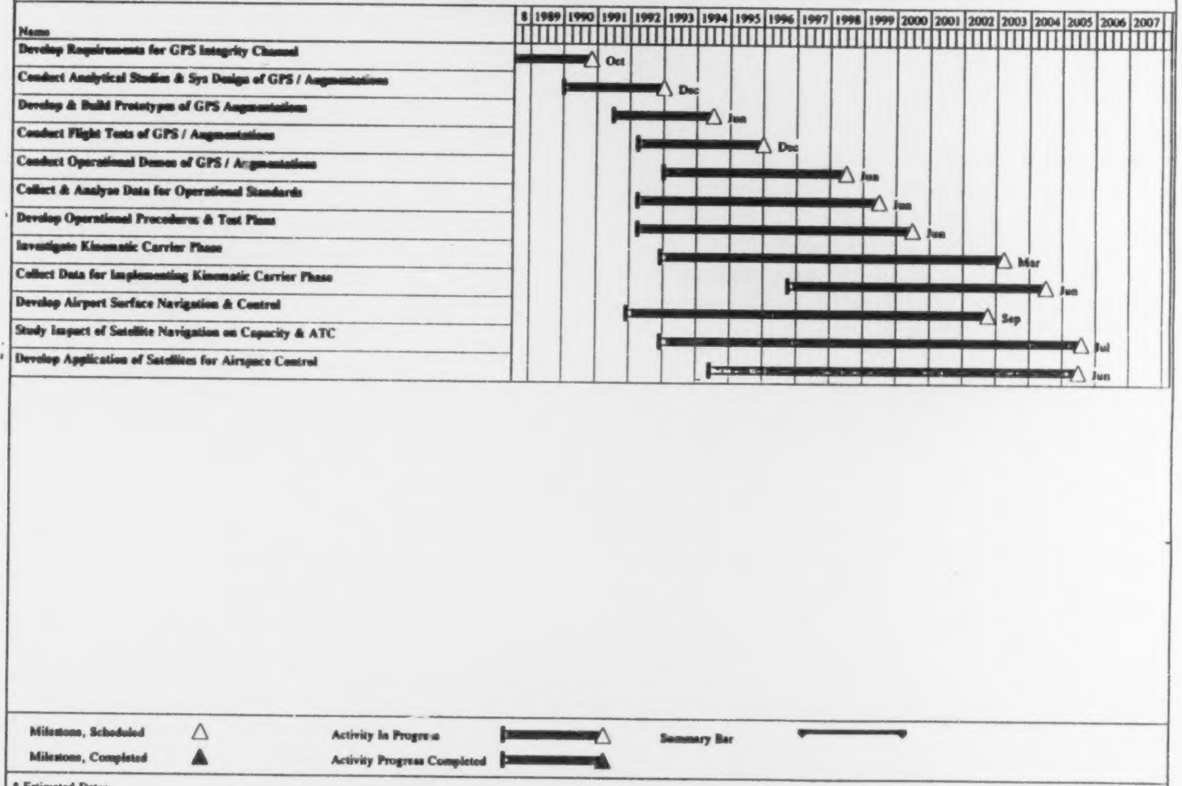
NAS Telecomm Architecture for 21st Century

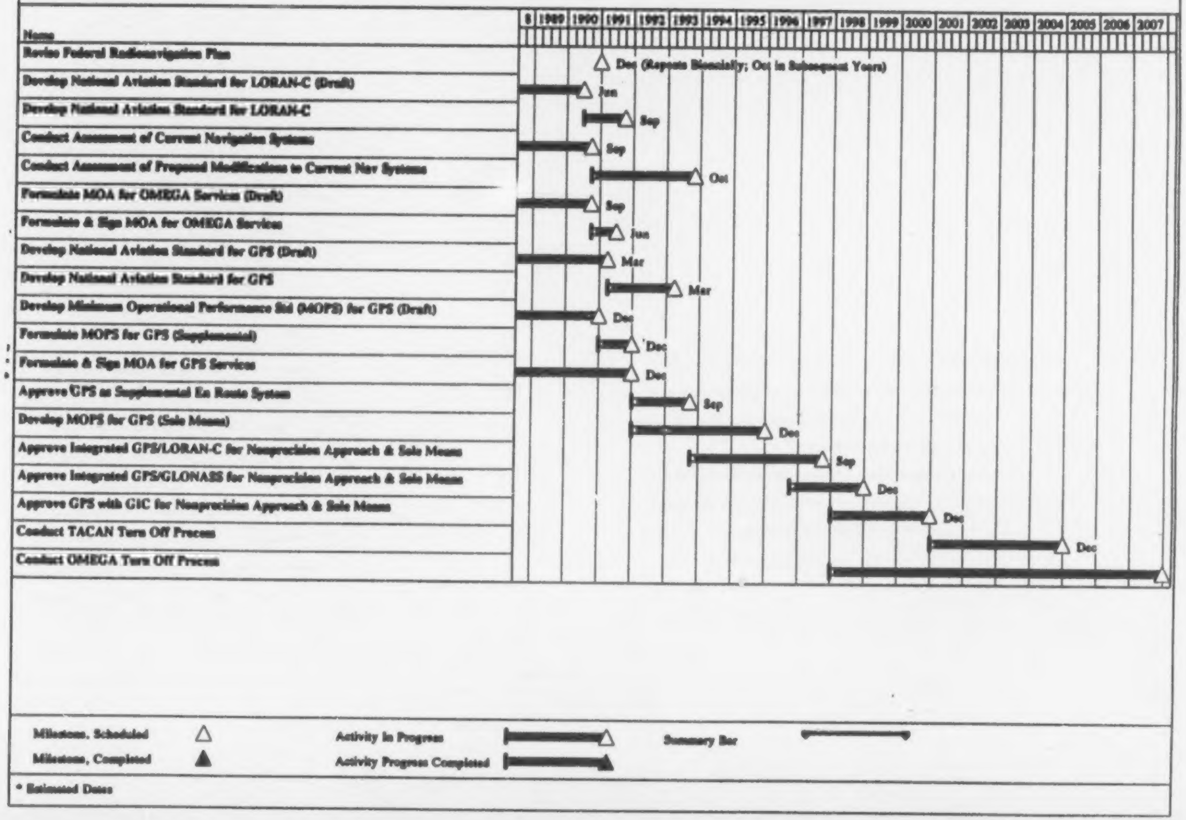


Satellite Navigation Program

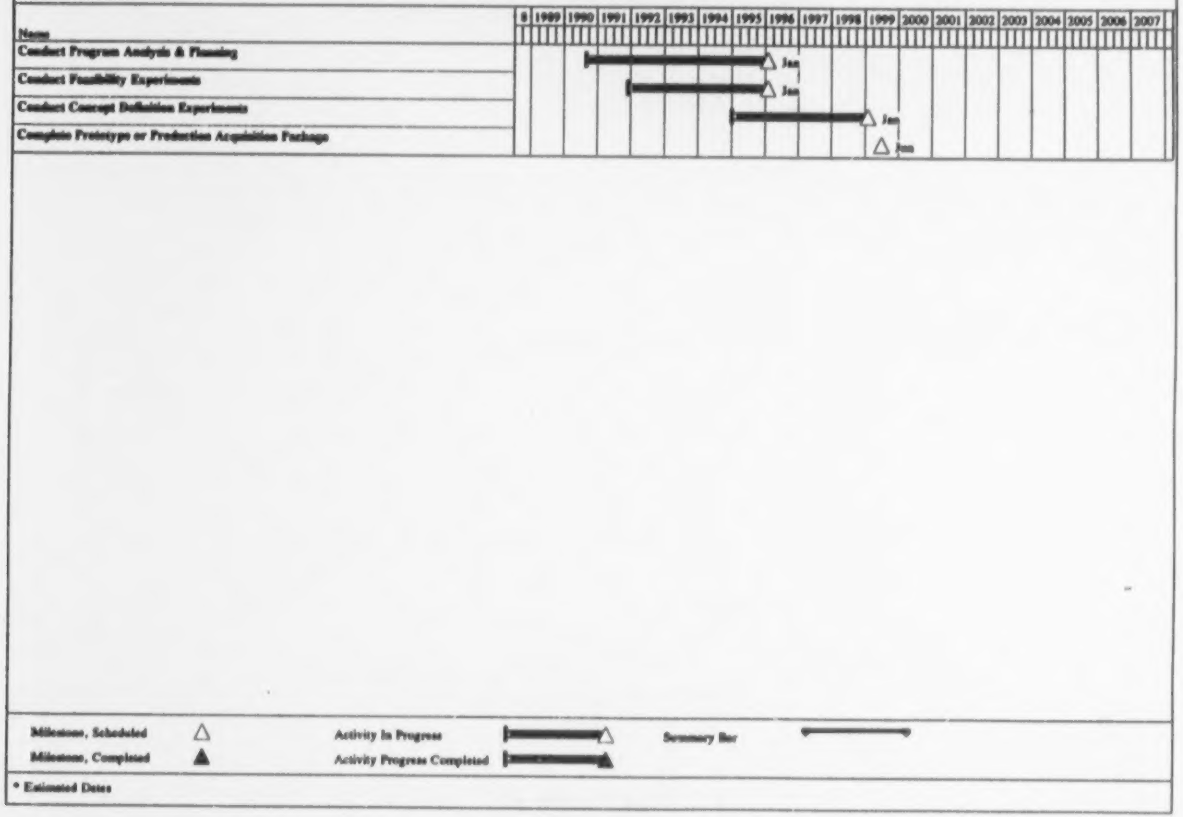


* Estimated Dates

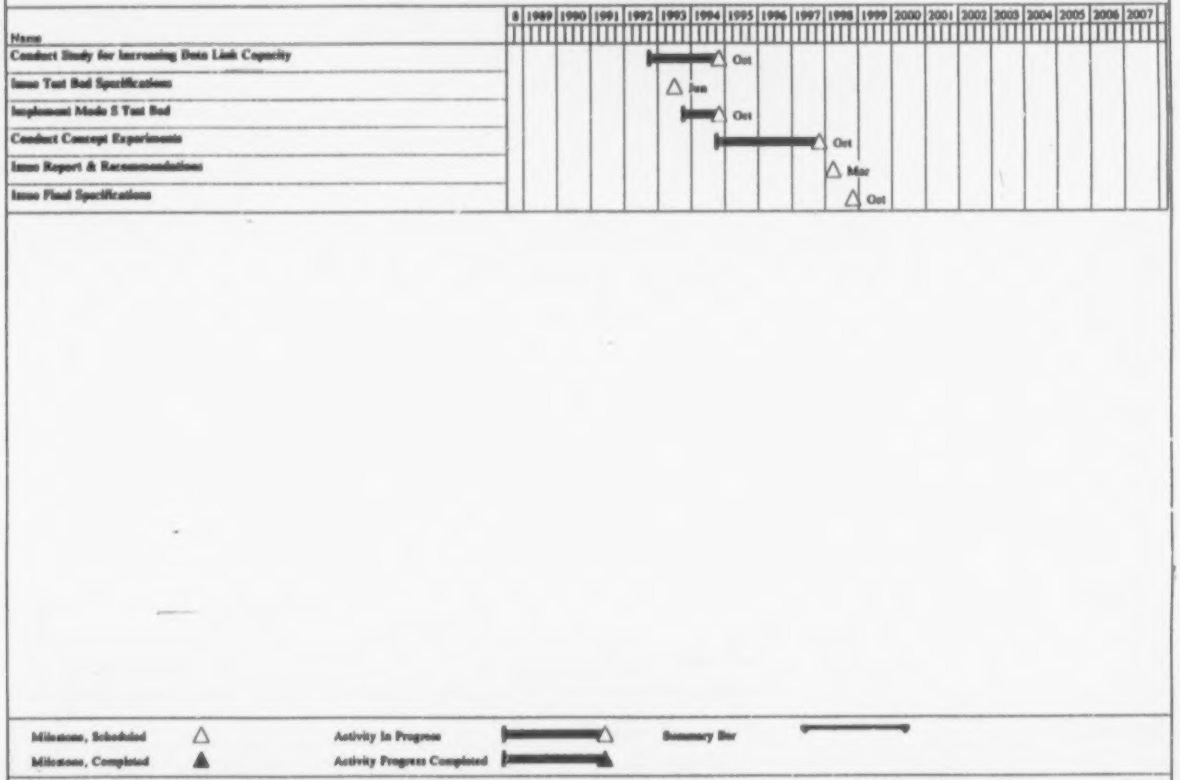
Navigation Systems Development



Terminal Surveillance Radar (TSR-1)



Mode S Sensor Enhancement



* Es.mated Dates

Question 4: Please provide a five-year F&E budget plan, in appropriately inflated dollars, and milestone schedule through FY-1996. Identify assumptions.

Answer:

F&E Budget Plan ($B)

FY92	FY93	FY94	FY96	FY97
2.70	3.00	2.90	2.50	2.50

Milestone Schedule

ASSUMPTIONS:

This Plan is based on the following assumptions:

- All segments of aviation including air carrier, commuter, and general aviation will continue to grow during the next 20 years.
- System limitations on any class of users' right-of-access to the system should be imposed only when no other recourse is available to ensure the common good.
- Specific equipment may be required aboard aircraft operating in designated airspace.
- Users' preferences for routes, runways, approaches, altitudes, etc., may not be honored if they will cause delays to other users or impair the safety of the system.
- No change to the system will be permitted that will reduce safety or increase risk. Mid-air collision protection, including a backup ground independent airborne separation device, TCAS, will be available.
- Few new, large, commercial-service airports are anticipated. Therefore, additional capacity will be achieved primarily through technological advances, refinements in ATC procedures, and airport surface improvements. Noise abatement procedures may affect all of these assumptions.
- ATC services within the NAS will continue to be provided by a mix of civil and military air traffic control facilities. Many military air traffic control facilities will provide service to civilian and military aircraft alike.

Question 5: Please indicate the number of FAA Full Time Equivalent (FTE) positions covered by the RE&D budget request. What is the cost of salaries and related expenses?

Answer:

The FAA Full Time Equivalent (FTE) positions covered by the FY1992 R,E&D budget request are 728. These positions are broken down as follows:

Capacity and Safety Research (Washington) - 201
Test and Evaluation (Technical Center) - 444
Aeromedical Research (Civil Aeromedial Institute) - 83

The cost of salaries and related expenses are $58,723 million. These costs identified by location are:

Washington - $16,875 million
Technical Center - $34,076 million
Civil Aeromedical Institute - $7,772

Question 6: For the projects listed below, please give the FY-1992 RE&D and/or F&E budget request. Also, show the combined budget if the project is conducted jointly with other agencies. In addition, please give the current estimates of project cost and date of completion for discrete projects (e.g. AERA III, ASTA, AAS, etc). Cost and completion date estimates are not necessary for general research areas (e.g. aging aircraft, human factors, etc.)

ATMS/TMS
AERA I
AERA II
AERA III
TATCA
ASTA
Precision Runway Monitor
ADS
GPS
Satellites
Aging Aircraft
Aircraft Safety
Airport Security
Human Factors
AWOS
CWP
Aeronautical Data Link
TDWR
HOST
AAS
VSCS
Mgmt & Control
NADIN
MLS
Airborne Windshear
NEXRAD
TDWR
Mode S
LLWAS
AFSS

Question 6. For the projects listed below, please give the FY-1992 RE&D and / or F&E budget request. Also, show the combined budget if the project is conducted jointly with other agencies. In addition, please give the current estimates of project cost and date of completion for discrete projects (e.g. AERA III, ASTA, AAS, etc.). Cost and completion date estimates are not necessary for general research areas (e.g. aging aircraft, human factors, etc.)

($'s in 000's)

Project	FY - 92 R,E&D Request	FY - 92 JOINT R&D Funding	Est Cost of Prog R,E&D	Est Comp Date R,E&D	FY - 92 F&E Request	FY - 92 Joint F&E Funding	Est Cost of Prog F&E	Est Comp Date F&E	Remarks
ATMS/TMS	4,000.0		83,873.0	2000	15,000.0		179,183.0	12/94	
AERA I	0.0			1987				06/2001	Funding included in AAS Program
AERA II	0.0			1986			162,340.0	03/2002	Funding included in AAS Program
AERA III	3,846.0		86,442.0	2007			TBD	TBD	
TATCA	11,021.0		178,588.0	2001	0.0		137,000.0	TBD	
ASTA	11,121.0		226,943.0	2002	0.0		130,200.0	TBD	
Precision Runway Mon.	0.0				15,000.0		78,600.0	TBD	
ADS	4,205.0		100,743.0	2007	6,800.0		32,045.0	12/94	
GPS	0.0		121,064.0	2007	2,900.0		38,700.0	TBD	
AWOS/ASOS	0.0		1,869.0		27,000.0	13,885.0 (NWS)	216,200.0	09/94	AWOS/ASOS combined EAC
CWP	269.0		49,231.0	1997	11,500.0		136,500.0	04/96	
TDWR	0.0				21,000.0		327,647.0	06/96	
HOST	0.0		121,100.0	1985	0.0		290,700.0	06/88	
AAS	4,180.0		110,338.0		557,800.0		4,453,726.0	12/2001	
VSCS	641.0		129,615.0		159,100.0		892,353.0	08/96	
NADIN	0.0		6,169.0	1991	5,900.0		52,195.0	01/96	NADIN I & NADIN II combined EAC
MLS	0.0				55,000.0		1,112,800.0	12/2004	

Question 6. For the projects listed below, please give the FY-1992 RE&D and / or F&E budget request. Also, show the combined budget if the project is conducted jointly with other agencies. In addition, please give the current estimates of project cost and date of completion for discrete projects (e.g. AERA III, ASTA, AAS, etc.). Cost and completion date estimates are not necessary for general research areas (e.g. aging aircraft, human factors, etc.)

($'s in 000's)

Project	FY - 92 R,E&D Request	FY - 92 JOINT R&D Funding	Est Cost of Prog R,E&D	Est Comp Date R,E&D	FY - 92 F&E Request	FY - 92 Joint F&E Funding	Est Cost of Prog F&E	Est Comp Date F&E	Remarks
NEXRAD	0.0				23,700.0	192,535.6 DOD/DOC	180,300.0	04/96	Joint FAA/DOD/DOC funds: FAA = 20%
Mode S	269.0		11,994.0	1997	47,800.0		424,778.8	12/96	
LLWAS	0.0		3,429.0	1991	4,100.0		52,400.0	10/92	
AFSS	0.0				36,800.0		424,500.0	01/95	
Satellites	2,673.0		53,923.0	2007					Considered general research
Aging Aircraft	13,175.0								Considered general research
Aircraft Safety	18,026.0	4,000.0 (NASA)							Considered general research
Airport Security	31,420.0								Considered general research
Human Factors	13,142.0								Considered general research
Aeronautical Data Link	11,160.0				17,600.0		234,441.0	TBD	Considered general research
Mgmt & Control	300.0								Considered general research
Airborne Windshear	3,073.0	1,405.0 (NASA)	53,508.0	2007					Considered general research